

INTEGRATED
Environmental Services, Inc.

Health-Based Remediation Goals for Surface Soils

McDonnell Douglas Realty Company
C-6 Facility, Parcel A

August 1997



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Los Angeles
California

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Prepared by
Integrated Environmental Services, Inc.

For the
McDonnell Douglas Realty Company

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ACRONYMS

ALCOA	Aluminum Company of America
ATSDR	Agency for Toxic Substances and Disease Registry
BTEX	benzene, toluene, ethylbenzene, xylenes
Cal/EPA	California Environmental Protection Agency
CEM	conceptual exposure model
CSF	cancer slope factor
CSV	chemical specific value
DAC	Douglas Aircraft Company
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EPA	Environmental Protection Agency (U.S.)
G&M	Geraghty & Miller
HBRG	health-based remediation goal
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
ILM	International Light Metals
IRIS	Integrated Risk Information System
LOAEL	lowest-observable-adverse-effect level
MDRC	McDonnell Douglas Realty Company
MCLG	maximum contaminant level goal
NOAEL	no-observable-adverse-effect level
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
POE	point of exposure
RAGS	Risk Assessment Guidance for Superfund
Rfc	reference concentration
RfD	reference dose
RME	reasonable maximum exposure
RSC	relative source contribution
RWQCB	Regional Water Quality Control Board
SVOC	semi-volatile organic compound
TEF	toxicity equivalence factor
TRPH	total recoverable petroleum hydrocarbon
UCL	upper confidence limit
VOC	volatile organic compound

1. INTRODUCTION

This document presents the health-based remediation goals (HBRGs) for surface soils at Parcel A of the McDonnell Douglas C-6 facility in Los Angeles, California. The methodology, assumptions, and calculations used to develop these values are described, as are the projected impacts on current and future site remediation and redevelopment. As used throughout this document, McDonnell Douglas Corporation and McDonnell Douglas Realty Company refer to wholly owned subsidiaries of The Boeing Company.

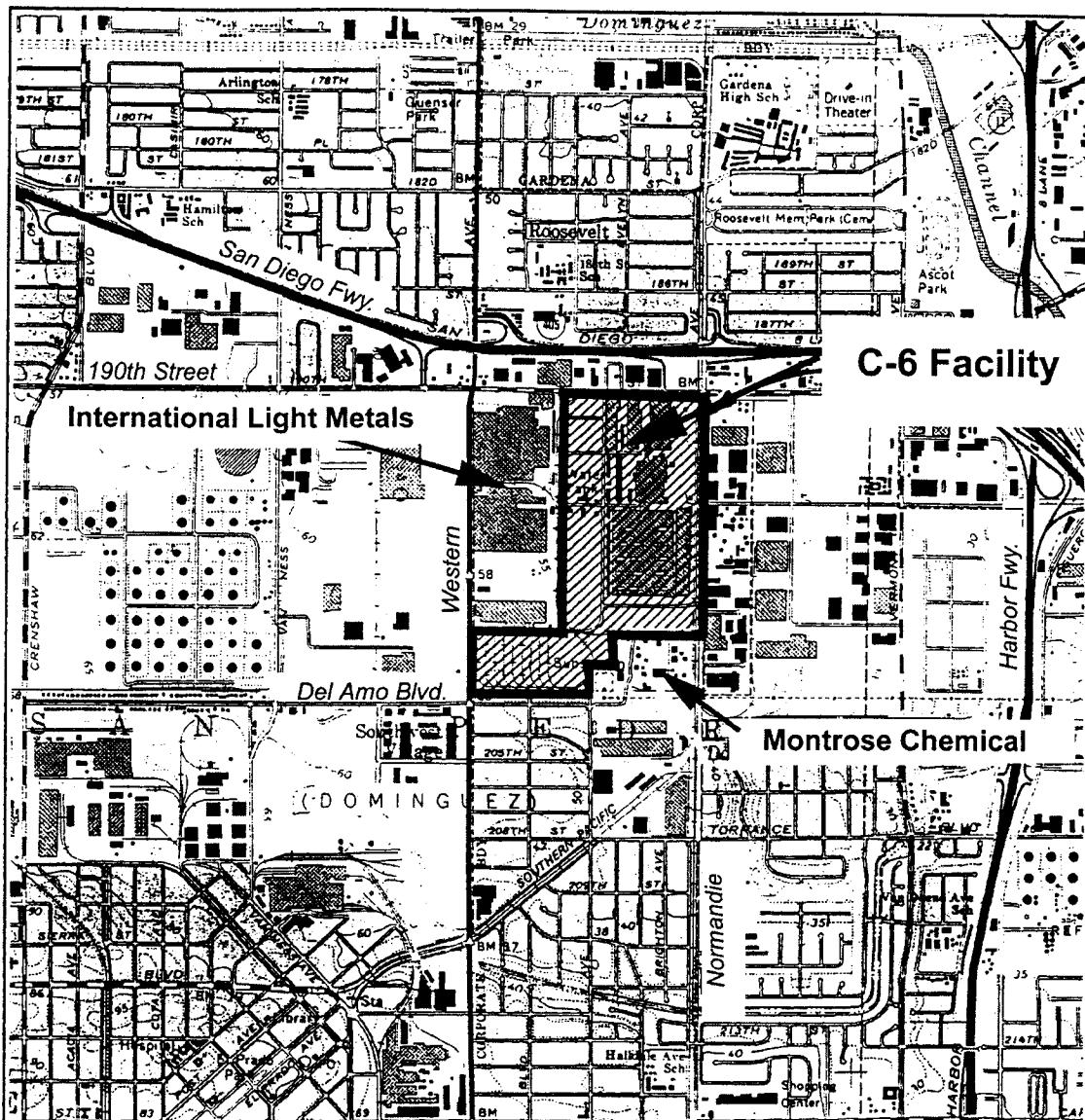
1.1 SITE HISTORY

The C-6 facility is located at 19503 South Normandie Avenue in Los Angeles, California (Figure 1-1). The 176-acre property is essentially flat with an elevation of approximately 50 feet above mean sea level. Historically a manufacturing complex, the site is currently used for warehousing. Figure 1-2 is a plot layout showing key buildings and other infrastructure; Parcel A is delineated.

The property is bordered by 190th Street on the north, Normandie Avenue on the east, 203rd Street on the south, and Western Avenue on the west. A railroad easement runs along the east side of the property between the fence and Normandie Avenue. The surrounding properties consist mainly of office buildings, light industrial and manufacturing facilities, and a residential neighborhood. Remediation activities are ongoing at the former International Light Metals (ILM) facility, which is adjacent to the C-6 facility's Parcel A, on the western border.

Aerial photographs indicate the area was farmland before the 1940s. Industrial use of the site began in 1941 when the Defense Plant Corporation developed it as part of an aluminum reduction plant. Five "pot lines" were originally constructed at the plant, but only three were placed in operation. The Aluminum Company of America (ALCOA) operated the plant for the government during World War II until it was closed in September 1944. The War Assets Administration then used the site for temporary storage during the following two years. In 1948, Columbia Steel Company purchased the property. No significant changes were made to the plant under Columbia's ownership (Kennedy/Jenks 1996, 1997).

In March 1952, the US Navy purchased the property and established the Douglas Aircraft Company (DAC) as the contractor and operator of the facility for the manufacture of aircraft and aircraft parts. DAC purchased the property from the Navy in 1970 and used the facility to manufacture components for various commercial and military aircraft until approximately 1992. DAC has used the C-6 facility for the storage and distribution of aircraft parts since cessation of manufacturing activities (Kennedy/Jenks 1996, 1997).

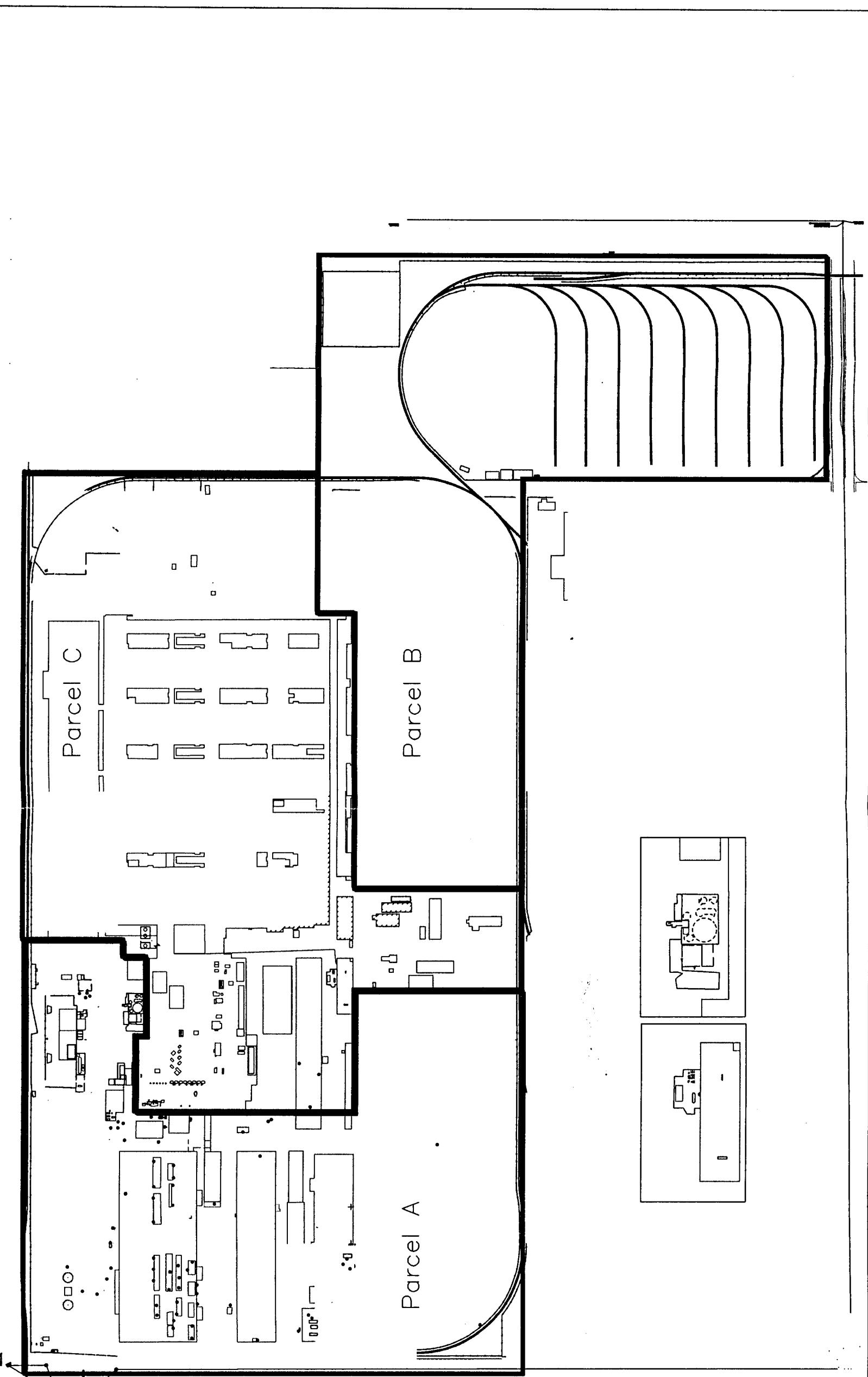


Base Map: U.S.G.S. 7.5 Minute Topographic Map,
Torrance, California Quadrangle, 1981.

0 2000 4000
Approximate Scale in Feet



Figure 1-1
McDonnell Douglas C-6
Facility and Vicinity



TITLE:

McDonnell Douglas C6 Facility Layout

PROJECT NO.:	2363
FIGURE NO.:	1-2

DWN:	DES.:
JL	
CHKD:	APPD.:
DATE:	REV.:
8-1-97	1



The current owner of the C-6 facility, McDonnell Douglas Realty Company (MDRC), began a phased redevelopment of the 170-acre property in 1996. As shown in Figure 1-2, the property has been divided into three parcels (A, B, and C). Redevelopment of the northernmost portion of the property, Parcel A, began in 1996 and is ongoing. Each parcel will undergo, as required, environmental investigation, assessment, and remediation prior to construction. MDRC is currently conducting remedial activities in Parcel A. As mentioned above, this document presents the remediation goals for Parcel A surface soils.

1.2 REMEDIATION STRATEGY

To expedite the redevelopment of Parcel A, surface soils and groundwater are undergoing separate remediation programs. Surface soils, defined as all soils to a depth of 12 feet below ground surface (bgs), are a concern due to their potential health impact to future site users. Groundwater, defined as the underlying saturated zones as well as all potential subsurface soil sources (below 12 feet bgs), is a concern because of its potential impact to the underlying aquifers. Groundwater and deep subsurface soils have not been addressed in this document as they are not believed to pose a risk to potential future site users. The following programmatic approach has been applied within Parcel A for the remediation of surface soils.

MDRC has adopted an "80/20" health-based remediation strategy for soils, to ensure health protectiveness throughout the expedited closure. Under this strategy, MDRC has developed and employed a set of remediation goals for use in the identification and remediation of potentially contaminated soils during demolition activities. The remediation goals could not be submitted for review prior to demolition because of the aggressive remediation and development schedule for the site. MDRC has acknowledged that the use of these unapproved remediation goals may require it to conduct additional remediation upon a complete agency review. The soils identified using the unapproved values are believed to represent roughly 80 percent of the required remediation effort.

The development of these remediation goals, although not prepared for immediate approval by the agencies, followed standard guidance for development of risk-based remediation goals as promulgated by the U.S. Environmental Protection Agency (EPA) and California Environmental Protection Agency (Cal/EPA) . In addition, MDRC has reviewed the recently approved baseline risk assessment and remediation goals documents for the adjacent Lockheed Martin ILM facility, and has incorporated agency approved assumptions and parameters where appropriate.

As Parcel A demolition nears completion, the remediation goals are now being submitted for agency review and approval. The resulting goals will be used to re-evaluate the Parcel A soils and identify areas requiring further remediation. This additional remediation, if necessary, represents the remaining 20 percent.

Following the completion of all surface soil remediation, a human health risk assessment will be conducted to confirm the health protectiveness of residual constituent concentrations within Parcel A.

1.3 OBJECTIVE

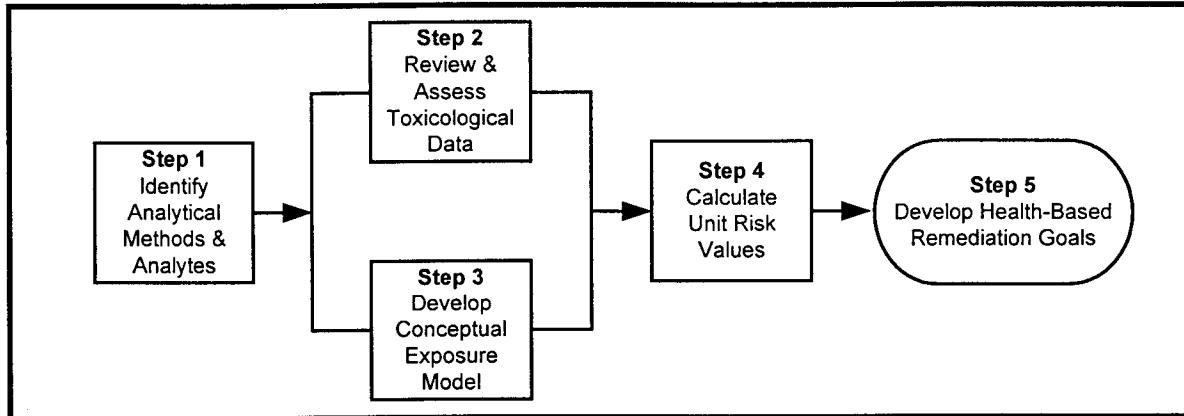
The objective of this document is to obtain agency approval of MDRC's chemical-specific health-based remediation goals (HBRGs) for the completion of Parcel A surface soil remediation. In accordance with the National Contingency Plan (EPA 1990a) and other guidelines published by the EPA, as well as guidelines from the Cal/EPA Department of Toxic Substances Control (DTSC), the remediation goals identified in this document have been developed with the purpose of protecting human health.

Two types of health effects may potentially result from exposure to chemical contaminants: carcinogenic and noncarcinogenic effects. In the National Contingency Plan (EPA 1990a), EPA has identified a target range for acceptable cancer risk of 1 in 1,000,000 (10^{-6}) to 1 in 10,000 (10^{-4}) for National Priority List (NPL) sites. This target range is designed to limit the possibility that an individual would develop cancer from exposure to site-related residual contaminants (EPA 1989a, 1991). As part of the cleanup effort at NPL sites, EPA strives to manage possible incremental lifetime cancer risk (ILCR) within this target range.

For noncarcinogenic effects, the hazard index (HI) represents the sum of hazard quotients (HQs) for multiple chemicals and/or multiple exposure pathways. The HQ is the ratio of a single chemical exposure level developed over a specified time period to a reference dose (RfD) developed over a similar time period. Therefore, an HI of less than 1 means the exposure to the toxicant is less than the level at which a toxic health effect may occur.

1.4 METHODOLOGY

This section summarizes the methodology used to derive HBRGs appropriate for the future land use of the site and ensure protection of human health. As shown in Figure 1-3, the methodology consists of five distinct steps, some of which may be performed concurrently.



**FIGURE 1-3
METHODOLOGY FOR CALCULATION OF REMEDIATION GOALS**

First, the EPA analytical methods associated with the soil site characterization effort were reviewed and the analytes associated with these methods compiled. The methods and analytes are listed below:

<u>EPA Method</u>	<u>Analyte</u>
335.3	Total cyanides
6010	California Code of Regulations listed metals
7420	Total lead
8020	Benzene, toluene, ethylbenzene, xylenes (BTEX)
8080	Polychlorinated biphenyls (PCBs)
8240	Volatile organic compounds (VOCs)
8270	Semivolatile organic compounds (SVOCs)

In Step 2 (Section 2 of this report), those analytes for which EPA toxicity data exist - as published in the California Cancer Potency Factors Update, the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST) - were selected for risk

analysis and evaluation in this document. For those analytes for which no toxicity data are available, HBRGs could not be established.

In Step 3 (Section 3), conceptual exposure scenarios were developed for the C-6 site to describe the potential soil exposures and provide a basis for quantifying these exposures. Each exposure scenario was developed to address the source of chemicals, route or mechanism of exposure, and potentially exposed populations (known as "receptors"). When site-specific data for scenario development were unavailable, conservative values found in the literature were used.

In Step 4 (Section 4), receptor-specific unit risk factors were calculated to quantify the potential human health risks associated with exposure to unit concentrations of analytes in soil. As a result of this effort, a linear relationship between the source term concentration (i.e., soil concentration) and receptor-specific risk was established. Specially designed databases were developed to calculate chemical-specific, multipathway unit risks for each of the hypothetical receptors.

In Step 5 (Section 5), the unit risk values were used to quantify source term concentrations equivalent to receptor-specific target risk levels. These new values represent the initial HBRGs for the identified receptor. The initial HBRGs underwent a final evaluation to ensure they are not only health protective but also reasonable; the resultant values are the final HBRGs. The initial HBRGs developed for organic constituents derive from two distinct exposure scenarios and must be normalized to ensure health protectiveness prior to setting final HBRGs. Final HBRGs for inorganic compounds must account for the potential impact of naturally occurring background concentrations.

To reiterate, this five-step procedure was developed specifically to ensure the final HBRGs are both health protective and reasonable (i.e., not below background levels).

Note: It is important to note that the large number of analytes presented in this report were compiled from EPA analytical methods; therefore, the number of analytes presented does not necessarily represent the anticipated list of chemicals of concern at the C-6 facility. The final list of chemicals of concern will be developed and presented in the Parcel A Post-Remediation Risk Assessment.

1.5 GUIDANCE

The following major guidance documents and/or information sources were used to prepare this document:

- ♦ Risk Assessment Guidance for Superfund (RAGS), Volume I - Human Health Evaluation Manual, Part A (EPA 1989a)
- ♦ Risk Assessment Guidance for Superfund (RAGS), Volume I - Human Health Evaluation Manual, Part B, Development of Risk-Based Preliminary Remediation Goals (EPA 1991)
- ♦ National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990a)
- ♦ Exposure Factors Handbook (EPA 1990b)
- ♦ Dermal Exposure Assessment, Principles and Applications (EPA 1992)
- ♦ California Cancer Potency Factors Update (Cal/EPA 1996)
- ♦ Integrated Risk Information System (IRIS) database (EPA 1997)
- ♦ Health Effects Assessment Summary Tables (HEAST) FY-1995 (EPA 1995)
- ♦ Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (Cal/EPA 1992)
- ♦ Preliminary Endangerment Assessment Guidance Manual (Cal/EPA 1994)

In addition to the above regulatory sources, this document has drawn upon the recently approved ILM Baseline Risk Assessment (G&M 1996). When used, this source is cited in the text.

1.6 REPORT ORGANIZATION

This report has five sections and three appendices.

- ♦ Section 1. Introduction
Provides the overview of the document.
- ♦ Section 2. Toxicological Information
Briefly explains the methods and assumptions used by Cal/EPA and U.S. EPA to set toxicity criteria. Explains how reference doses and cancer slope factors are established to assess, respectively, noncarcinogenic and carcinogenic risk. Explains how these toxicity criteria are adjusted for dermal exposure assessments, and the approach to the toxicity equivalence factors method used to assess the cancer risk from mixtures of structurally related compounds such as PCBs, chlorinated dibenzodioxins/furans, and polycyclic aromatic hydrocarbons (PAHs).

- ♦ Section 3. Exposure Assessment

Describes the post-remediation exposure setting for Parcel A and presents the rationale and development of the appropriate conceptual exposure models.

- ♦ Section 4. Calculation of Unit Risk

Presents the calculation of unit risk and unit toxicity for the identified significant exposure pathways.

- ♦ Section 5. Development of Health-Based Remediation Goals

Presents the quantitative methodologies used to develop the chemical-specific, receptor-specific HBRGs. Refers to the study conducted for the adjacent ILM facility to determine inorganic background concentrations. The HBRGs developed in this section will be used to evaluate the health protectiveness of surface soil residual concentrations throughout the Parcel A remedial operation.

- ♦ Section 6. References

Lists literature cited in this report.

To assist the reader in understanding how the unit risk values and subsequent HBRGs were derived, additional information is presented in appendices:

- ♦ Appendix A provides the intake and unit risk calculation sheets for the construction worker incidental ingestion exposures.
- ♦ Appendix B contains the intake and unit risk calculation sheets for the construction worker dermal contact exposures.
- ♦ Appendix C presents the intake and unit risk calculation sheets for the inhalation pathway for both the commercial/industrial user and the construction worker.
- ♦ The calculation of initial HBRGs for the construction worker and commercial/industrial user are summarized in Appendix D.
- ♦ Appendix E provides a copy of the Background Evaluation Section of the Lockheed Martin ILM Baseline Risk Assessment (G&M 1996).

2. TOXICOLOGICAL INFORMATION

The objective of this section is to provide information on the toxic effects of chemical exposure. Table 2-1 is the comprehensive list of chemicals which can be identified under the analytical methods used at the site and subjected to toxicological review. For each chemical, toxicological information was drawn from the California Cancer Potency Factors Update (Cal/EPA 1996) or IRIS (EPA 1997) and, for provisional data, HEAST (EPA 1995). This section discusses in qualitative terms the potential adverse biological effects associated with human exposure to these chemicals. For chemicals lacking toxicological data (Table 2-2), health-based remediation goals (HBRGs) could not be developed.

EPA's methods and assumptions for setting toxicity criteria are presented. Section 2.1 explains how reference concentrations/doses are established to assess noncarcinogenic risk (Section 2.1.1) and how slope factors are identified to calculate the incremental lifetime cancer risk (ILCR) associated with exposure to chemical carcinogens under evaluation (Section 2.1.2). Section 2.2 explains how the toxicity criteria are adjusted for dermal exposure assessments. Section 2.3 describes toxicity equivalence factors, which are used to assess the cancer risk from mixtures of structurally related compounds such as PCBs, chlorinated dibenzodioxins/furans, and PAHs. Section 2.4 describes the complexity of assessing lead exposures and how lead remediation goals will be determined for the Parcel A remediation.

2.1 TOXICITY CRITERIA

2.1.1 Noncarcinogens

For the noncarcinogenic potential effects of chemicals, EPA assumes a dose exists below which no adverse health effects will be seen (EPA 1989b). Below this threshold, it is believed that exposure to a chemical can be tolerated without adverse effects, and the body burden is not increased. Toxic effects potentially become manifest only when physiologic protective mechanisms are overcome by exposure doses above the threshold. Since this threshold reflects a body burden (i.e., the concentration of a compound per unit body mass), the reference concentration (RfC) must be normalized to accurately reflect the specific receptor of concern. This normalized value is referred to as the reference dose (RfD).

RfDs are expressed in units of milligrams per kilogram-day (mg/kg-d) and represent the daily intake (averaged over a year) of chemical per kilogram of body weight which is below the potential effect threshold for that chemical. In essence, the RfD represents the receptor-specific threshold dose.

TABLE 2-1
ANALYTICAL-METHOD-SPECIFIC
CONSTITUENTS WITH TOXICITY VALUES¹

1-butanol	4-methylphenol	bis(2-chloroethyl)ether
1,1-dichloroethane	4,4-ddd	bis(2-ethylhexyl)phthalate
1,1-dichloroethene	4,4-dde	bromodichloromethane
1,1,1,2-tetrachloroethane	4,4-ddt	bromoform
1,1,2-trichloroethane	acenaphthene	bromomethane
1,1,2,2-tetrachloroethane	acetone	cadmium
1,2-dibromo-3-chloropropane	acrolein	carbazole
1,2-dibromoethane	acrylonitrile	carbon disulfide
1,2-dichlorobenzene	aldrin	carbon tetrachloride
1,2-dichloroethane	alpha-bhc	chlordan
1,2-dichloropropane	aniline	chlorobenzene
1,2-diphenylhydrazine	anthracene	chloroform
1,2,3-trichloropropane	antimony	chloromethane
1,2,4-trichlorobenzene	aroclor 1016	chromium iii
1,3-dichloropropene	aroclor 1254	chromium vi
1,4-dichlorobenzene	arsenic	chrysene
2-butanone	barium	cis-1,2-dichloroethene
2-chlorophenol	benzene	copper
2-methylphenol	benzidine	cumene
2-naphthylamine	benzoic acid	cyanide
2,4-dichlorophenol	benzo(a)anthracene	dibenzo(a,h)anthracene
2,4-dimethylphenol	benzo(a)pyrene	dibromochloromethane
2,4-dinitrophenol	benzo(b)fluoranthene	dichlorodifluoromethane
2,4-dinitrotoluene	benzo(k)fluoranthene	dieldrin
2,4,5-trichlorophenol	benzyl alcohol	diethyl phthalate
2,4,6-trichlorophenol	benzyl chloride	di-n-butylphthalate
2,6-dinitrotoluene	beryllium	di-n-octylphthalate
3,3-dichlorobenzidine	beta-bhc	endosulfan
4-chloroaniline	beta-chloronaphthalene	endrin
4-methyl-2-pentanone	bis(2-chloro-1-methylethyl)ether	ethyl chloride

TABLE 2-1 (CONT.)
ANALYTICAL-METHOD-SPECIFIC
CONSTITUENTS WITH TOXICITY VALUES¹

ethylbenzene	methylene bromide	pyrene
fluoranthene	methylene chloride	selenium
fluorene	methyl-tert-butyl ether	silver
gamma-bhc	molybdenum	styrene
heptachlor	n-butylbenzyl phthalate	tetrachloroethene
heptachlor epoxide	toluene	
hexachlorobenzene	nitroaniline, o-	toxaphene
hexachlorobutadiene	nitrobenzene	trans-1,2-dichloroethene
hexachlorocyclopentadiene	nitrosodiphenylamine, p-	trichloroethene
hexachloroethane	n-nitrosodimethylamine	trichlorofluoromethane
indeno(1,2,3-cd)pyrene	n-nitroso-di-n-propylamine	vanadium
isobutyl alcohol	n-nitrosodiphenylamine	vinyl acetate
isophorone	o-chlorotoluene	vinyl chloride
mercury	p-chloro-m-cresol	xlenes
methoxychlor	pentachlorophenol	zinc
methyl methacrylate	phenol	

SOURCES:

- 1 - Not all constituents are found at subject C-6 Facility
 California Cancer Potency Factors Update (Cal/EPA 1996)
 IRIS (EPA 1997)
 HEAST (EPA 1995)

TABLE 2-2
ANALYTICAL-METHOD-SPECIFIC
CONSTITUENTS LACKING TOXICITY DATA

1,1,1-trichloroethane	4,6-dinitro-2-methylphenol	dimethylphthalate
1,1,2-trichloro-1,2,2-trifluoroethane	acenaphthylene	iron
1,2-dichloro-1,1,2,2-tetrafluoroethane	aluminum	lead
1,3-dichlorobenzene	aroclor-1260	naphthalene
1,3-dichloropropane	benzo(g,h,i)perylene	p-nitrophenol
1,3,5-trimethylbenzene	bis(2-chloroethoxy)methane	m-nitroaniline
2-hexanone	bromochloromethane	p-nitroaniline
2-methylnaphthalene	calcium	phenanthrene
2,2-dichloropropane	chloroethane	potassium
2,2-oxy-bis(1-chloropropane)	cobalt	sodium
4-bromophenyl phenyl ether	m-chlorotoluene	thallium
4-chloro-3-methylphenol	p-chlorotoluene	titanium
4-chlorophenyl phenyl ether	delta-BHC	trans-1,3-dichloropropene
4-ethyl toluene	dibenzofuran	

SOURCES:

California Cancer Potency Factors Update (Cal/EPA 1996)
 IRIS (EPA 1997)
 HEAST (EPA 1995)

In addition, the EPA assumes noncarcinogenic exposure doses are not cumulative from age group to age group over a lifetime of exposure (EPA 1989b). An RfD is specific to the chemical, route of exposure, and duration over which the exposure occurs.

The EPA reviews all relevant human and animal studies for each compound and selects the studies pertinent to the derivation of specific RfDs. Each study is evaluated to determine the no-observable-adverse-effect level (NOAEL) or, if data are inadequate for such a determination, the lowest-observable-adverse-effect level (LOAEL). The NOAEL corresponds to the dose (mg/kg-d) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose (mg/kg-d) that can be administered over a lifetime that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect."

To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for: 1) extrapolation of data from laboratory animals to humans (interspecies extrapolation), 2) variation in human sensitivity to the toxic effects of a compound (intraspecies differences), 3) derivation of a chronic RfD based on a subchronic rather than a chronic study, and 4) derivation of an RfD from the LOAEL rather than the NOAEL. Each of these uncertainties usually represents a factor of 10. In addition to these uncertainty factors, modifying factors between 0 and 10 may be applied to reflect additional qualitative considerations in evaluating the data (EPA 1989b).

The RfDs for noncarcinogenic chemicals are presented in Table 2-3. The primary source for toxicological reference values is IRIS, an on-line database that contains current health risk and regulatory information (EPA 1997). Provisional RfDs are tabulated in HEAST (EPA 1995). Surrogate chemicals were not used to derive any RfD values.

The noncarcinogenic risk associated with a chemical exposure is expressed as the hazard quotient (HQ). The HQ is a ratio of the estimated chemical intake based on the measured or calculated exposure concentration for a chemical (dose), divided by the appropriate pathway-specific RfD. If the HQ exceeds 1, there is a potential for adverse effect. If the HQ is equal to or less than 1, the exposure level is not likely to cause adverse effects. If exposure to multiple chemicals occurs, the potential for adverse effects is assessed by summing the HQs and is designated the hazard index (HI).

In keeping with EPA guidance (EPA 1989b), all noncarcinogenic risk was considered additive for individual receptors. Since the noncarcinogenic chemicals under investigation at the site are associated with various adverse effects on distinct target organs and systems, the assumption of additivity of effects may overstate the potential for such effects. The effects of additivity will be addressed in the confirmation risk assessment to be conducted following the completion of all soil remediation activities.

2.1.2 Carcinogens

The incremental lifetime cancer risk (ILCR) from a chemical carcinogen is calculated as a product of the reasonable maximum daily intake (mg/kg-d) and the cancer slope factor (CSF). EPA's model of chemical carcinogenesis assumes the relationship between exposure to a carcinogen and cancer risk is linear over the entire dose range, except at very low doses (EPA 1989a). This linearity assumes that there is no threshold or exposure dose below which no adverse effects will occur. Because of this, carcinogenic effects are considered to be cumulative across age groups when considering lifetime exposures.

TABLE 2-3
REFERENCE DOSES

Constituent	Chronic Exposures		Subchronic Exposures	
	Oral (mg/kg-d)	Inhalation* (mg/kg-d)	Oral (mg/kg-d)	Inhalation* (mg/kg-d)
1-butanol	1.00E-01	1.00E-01	1.00E+00	1.00E+00
1,1-dichloroethane	1.00E-01	1.43E-01	1.00E+00	1.43E+00
1,1-dichloroethene	9.00E-03	9.00E-03	9.00E-03	9.00E-03
1,1,1,2-tetrachloroethane	3.00E-02	3.00E-02	3.00E-02	3.00E-02
1,1,2-trichloroethane	4.00E-03	4.00E-03	4.00E-02	4.00E-02
1,1,2,2-tetrachloroethane	NA	NA	NA	NA
1,2-dibromo-3-chloropropane	NA	5.71E-05	NA	5.71E-05
1,2-dibromoethane	NA	5.71E-05	NA	5.71E-04
1,2-dichlorobenzene	9.00E-02	5.71E-02	NA	NA
1,2-dichloroethane	NA	NA	NA	NA
1,2-dichloropropane	NA	1.14E-03	NA	3.71E-03
1,2-diphenylhydrazine	NA	NA	NA	NA
1,2,3-trichloropropane	6.00E-03	6.00E-03	6.00E-02	6.00E-02
1,2,4-trichlorobenzene	1.00E-02	5.71E-02	1.00E-02	5.71E-01
1,3-dichloropropene	3.00E-04	5.71E-03	3.00E-03	5.71E-03
1,4-dichlorobenzene	NA	2.29E-01	NA	7.14E-01
2-butanone	6.00E-01	2.86E-01	2.00E+00	2.86E+00
2-chlorophenol	5.00E-03	5.00E-03	5.00E-02	5.00E-02
2-methylphenol	5.00E-02	5.00E-02	5.00E-01	5.00E-01
2-naphthylamine	NA	NA	NA	NA
2,4-dichlorophenol	3.00E-03	3.00E-03	3.00E-03	3.00E-03
2,4-dimethylphenol	2.00E-02	2.00E-02	2.00E-01	2.00E-01
2,4-dinitrophenol	2.00E-03	2.00E-03	2.00E-03	2.00E-03
2,4-dinitrotoluene	2.00E-03	2.00E-03	2.00E-03	2.00E-03
2,4,5-trichlorophenol	1.00E-01	1.00E-01	1.00E+00	1.00E+00
2,4,6-trichlorophenol	NA	NA	NA	NA
2,6-dinitrotoluene	1.00E-03	1.00E-03	1.00E-02	1.00E-02
3,3-dichlorobenzidine	NA	NA	NA	NA

TABLE 2-3 (CONT.)

Constituent	Chronic Exposures		Subchronic Exposures	
	Oral (mg/kg-d)	Inhalation* (mg/kg-d)	Oral (mg/kg-d)	Inhalation* (mg/kg-d)
4-chloroaniline	4.00E-03	4.00E-03	4.00E-03	4.00E-03
4-methyl-2-pentanone	8.00E-02	2.29E-02	8.00E-01	2.29E-01
4-methylphenol	5.00E-03	5.00E-03	5.00E-03	5.00E-03
4,4-ddd	NA	NA	NA	NA
4,4-dde	NA	NA	NA	NA
4,4-ddt	5.00E-04	5.00E-04	5.00E-04	5.00E-04
acenaphthene	6.00E-02	6.00E-02	6.00E-01	6.00E-01
acetone	1.00E-01	1.00E-01	1.00E+00	1.00E+00
acrolein	2.00E-02	5.71E-06	NA	NA
acrylonitrile	1.00E-03	5.71E-04	1.00E-02	1.00E-02
aldrin	3.00E-05	3.00E-05	3.00E-05	3.00E-05
alpha-bhc	NA	NA	NA	NA
aniline	NA	2.86E-04	NA	2.86E-04
anthracene	3.00E-01	3.00E-01	3.00E-01	3.00E-01
antimony	4.00E-04	4.00E-04	4.00E-04	4.00E-04
aroclor 1016	7.00E-05	7.00E-05	NA	NA
aroclor 1254	2.00E-05	2.00E-05	5.00E-05	5.00E-05
arsenic	3.00E-04	3.00E-04	3.00E-04	3.00E-04
barium	7.00E-02	1.43E-04	7.00E-02	1.43E-03
benzene	NA	NA	NA	NA
benzidine	3.00E-03	3.00E-03	3.00E-03	3.00E-03
benzoic acid	4.00E+00	4.00E+00	4.00E+00	4.00E+00
benzo(a)anthracene	NA	NA	NA	NA
benzo(a)pyrene	NA	NA	NA	NA
benzo(b)fluoranthene	NA	NA	NA	NA
benzo(k)fluoranthene	NA	NA	NA	NA
benzyl alcohol	3.00E-01	3.00E-01	1.00E+00	1.00E+00
benzyl chloride	NA	NA	NA	NA
beryllium	5.00E-03	5.00E-03	5.00E-03	5.00E-03
beta-bhc	NA	NA	NA	NA
beta-chloronaphthalene	8.00E-02	8.00E-02	NA	NA

TABLE 2-3 (CONT.)

Constituent	Chronic Exposures		Subchronic Exposures	
	Oral (mg/kg-d)	Inhalation* (mg/kg-d)	Oral (mg/kg-d)	Inhalation* (mg/kg-d)
bis(2-chloro-1-methylethyl)ether	NA	NA	NA	NA
bis(2-chloroethyl)ether	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	2.00E-02	2.00E-02	NA	NA
bromodichloromethane	2.00E-02	2.00E-02	2.00E-02	2.00E-02
bromoform	2.00E-02	2.00E-02	2.00E-02	2.00E-02
bromomethane	1.40E-03	1.43E-03	NA	NA
cadmium	5.00E-04	5.00E-04	5.00E-04	5.00E-04
carbazole	NA	NA	NA	NA
carbon disulfide	1.00E-01	2.00E-01	1.00E-01	2.00E-01
carbon tetrachloride	7.00E-04	7.00E-04	NA	NA
chlordan	6.00E-05	6.00E-05	6.00E-05	6.00E-05
chlorobenzene	2.00E-02	5.71E-03	NA	NA
chloroform	1.00E-02	1.00E-02	1.00E-02	1.00E-02
chloromethane	NA	NA	NA	NA
chromium iii	1.00E+00	1.00E+00	1.00E+00	1.00E+00
chromium vi	5.00E-03	5.00E-03	2.00E-02	2.00E-02
chrysene	NA	NA	NA	NA
cis-1,2-dichloroethene	1.00E-02	1.00E-02	1.00E-01	1.00E-01
copper	3.70E-02	3.70E-02	3.70E-02	3.70E-02
cumene	4.00E-02	2.57E-03	4.00E-01	2.57E-02
cyanide	2.00E-02	2.00E-02	2.00E-02	2.00E-02
dibenzo(a,h)anthracene	NA	NA	NA	NA
dibromochloromethane	2.00E-02	2.00E-02	2.00E-01	2.00E-01
dichlorodifluoromethane	2.00E-01	5.71E-02	9.00E-01	5.71E-01
dieldrin	5.00E-05	5.00E-05	5.00E-05	5.00E-05
diethyl phthalate	8.00E-01	8.00E-01	8.00E+00	8.00E+00
di-n-butylphthalate	1.00E-01	1.00E-01	1.00E+00	1.00E+00
di-n-octylphthalate	2.00E-02	2.00E-02	2.00E-02	2.00E-02
endosulfan	6.00E-03	6.00E-03	6.00E-03	6.00E-03
endrin	3.00E-04	3.00E-04	3.00E-04	3.00E-04

TABLE 2-3 (CONT.)

Constituent	Chronic Exposures		Subchronic Exposures	
	Oral (mg/kg-d)	Inhalation* (mg/kg-d)	Oral (mg/kg-d)	Inhalation* (mg/kg-d)
ethyl chloride	NA	2.86E+00	NA	2.86E+00
ethylbenzene	1.00E-01	2.86E-01	NA	NA
fluoranthene	4.00E-02	4.00E-02	4.00E-01	4.00E-01
fluorene	4.00E-02	4.00E-02	4.00E-01	4.00E-01
gamma-bhc	3.00E-04	3.00E-04	3.00E-03	3.00E-03
heptachlor	5.00E-04	5.00E-04	5.00E-04	5.00E-04
heptachlor epoxide	1.30E-05	1.30E-05	1.30E-05	1.30E-05
hexachlorobenzene	8.00E-04	8.00E-04	NA	NA
hexachlorobutadiene	2.00E-04	2.00E-04	NA	NA
hexachlorocyclopentadiene	7.00E-03	2.00E-05	7.00E-02	2.00E-04
hexachloroethane	1.00E-03	1.00E-03	1.00E-02	1.00E-02
indeno(1,2,3-cd)pyrene	NA	NA	NA	NA
isobutyl alcohol	3.00E-01	3.00E-01	3.00E+00	3.00E+00
isophorone	2.00E-01	2.00E-01	2.00E+00	2.00E+00
mercury	3.00E-04	8.57E-05	3.00E-04	8.57E-05
methoxychlor	5.00E-03	5.00E-03	5.00E-03	5.00E-03
methyl methacrylate	8.00E-02	8.00E-02	8.00E-02	8.00E-02
methylene bromide	1.00E-02	1.00E-02	1.00E-01	1.00E-01
methylene chloride	6.00E-02	8.57E-01	6.00E-02	8.57E-01
methyl-tert-butyl ether	NA	8.57E-01	NA	NA
molybdenum	5.00E-03	5.00E-03	4.00E-02	4.00E-02
n-butylbenzyl phthalate	2.00E-01	2.00E-01	2.00E-01	2.00E-01
nickel	2.00E-02	2.00E-02	2.00E-02	2.00E-02
nitroaniline, o-	NA	5.71E-05	NA	5.71E-04
nitrobenzene	5.00E-04	5.71E-04	5.00E-03	5.71E-03
nitrosodiphenylamine, p-	NA	NA	NA	NA
n-nitrosodimethylamine	NA	NA	NA	NA
n-nitroso-di-n-propylamine	NA	NA	NA	NA
n-nitrosodiphenylamine	NA	NA	NA	NA
o-chlorotoluene	2.00E-02	2.00E-02	2.00E-01	2.00E-01
p-chloro-m-cresol	NA	NA	2.00E+00	2.00E+00

TABLE 2-3 (CONT.)

Constituent	Chronic Exposures		Subchronic Exposures	
	Oral (mg/kg-d)	Inhalation* (mg/kg-d)	Oral (mg/kg-d)	Inhalation* (mg/kg-d)
pentachlorophenol	3.00E-02	3.00E-02	3.00E-02	3.00E-02
phenol	6.00E-01	6.00E-01	6.00E-01	6.00E-01
pyrene	3.00E-02	3.00E-02	3.00E-01	3.00E-01
selenium	5.00E-03	5.00E-03	5.00E-03	5.00E-03
silver	5.00E-03	5.00E-03	5.00E-03	5.00E-03
styrene	2.00E-01	2.86E-01	NA	8.57E-01
tetrachloroethene	1.00E-02	1.00E-02	1.00E-01	1.00E-01
toluene	2.00E-01	1.14E-01	2.00E+00	2.00E+00
toxaphene	NA	NA	NA	NA
trans-1,2-dichloroethene	2.00E-02	2.00E-02	2.00E-01	2.00E-01
trichloroethene	NA	NA	NA	NA
trichlorofluoromethane	3.00E-01	2.00E-01	7.00E-01	2.00E+00
vanadium	7.00E-03	7.00E-03	7.00E-03	7.00E-03
vinyl acetate	1.00E+00	5.71E-02	1.00E+00	5.71E-02
vinyl chloride	NA	NA	NA	NA
xylenes	2.00E+00	2.00E+00	2.00E+00	2.00E+00
zinc	3.00E-01	3.00E-01	3.00E-01	3.00E-01

NOTES:

NA = Not Available. No toxicity data exist for pathway.

*Inhalation RfDs equal to oral RfD when pathway-specific value not available

SOURCES:

California Cancer Potency Factors Update (Cal/EPA 1996)

IRIS (EPA 1997)

HEAST (EPA 1995)

CSFs are upper-bound (95 percent upper confidence limit [UCL]) estimates of the increased cancer risk per unit dose, in which risk is expressed as the probability that an individual will develop cancer within his or her lifetime as the result of exposure to a given level of a carcinogen. All cancers or tumors are considered whether or not death occurs as a result. This approach is inherently conservative because of the no-threshold assumption and the use of the 95 percent UCL of the estimated slope of dose versus cancer risk.

In addition to the CSF, the toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification. EPA groups chemicals according to their potential for carcinogenic effects based on clinical evidence (EPA 1989a):

- ♦ Group A A human carcinogen
- ♦ Group B1 or B2 A probable human carcinogen
- ♦ Group C A possible human carcinogen
- ♦ Group D Insufficient data to classify as a human carcinogen
- ♦ Group E Not a human carcinogen

The CSFs for chemicals studied in this report are presented in Table 2-4. The primary sources for toxicological reference values are the California Cancer Potency Factors Update (Cal/EPA 1996) and IRIS (EPA 1997). Provisional CSFs are tabulated in HEAST (EPA 1995). Surrogate chemicals were not used to derive any CSF values.

2.2 QUANTIFYING DERMAL EXPOSURE RISKS

Dermal RfD values and CSFs are derived from the corresponding oral values (EPA 1989a). In the derivation of a dermal RfD, the oral RfD is multiplied by the gastrointestinal (GI) absorption factor. The resulting dermal RfD is based on the absorbed dose, which is the appropriate value with which to compare a dermal dose absorbed through the skin. In a similar manner, a dermal CSF is derived by dividing the oral CSF by the GI absorption efficiency. The oral CSF is divided, rather than multiplied, by the GI absorption efficiency because CSFs are expressed as reciprocal dose (EPA 1992). Table 2-5 presents the GI absorption efficiencies and noncarcinogenic dermal toxicity values used in this report. Table 2-6 summarizes the carcinogenic dermal toxicity factors.

The most important consideration regarding the uncertainty associated with a dermal RfD or CSF is the accuracy of the GI absorption efficiency factor. Where appropriate, the low (most conservative) end of the range of available GI absorption data for humans is used in the derivation of the dermal RfD or CSF (Cal/EPA 1996, EPA 1995, 1997). When the human data are insufficient, animal data are used. Data from high-dose experiments are not used if more suitable data are available and it appears that saturation of the GI absorption process could have occurred. When sufficient quantitative data are not available, a default GI absorption factor is used. As noted by EPA (1989a), the absorption of many metals from the GI tract is limited, and a GI absorption fraction of 0.05 is provided as a reasonable default for metals and inorganic substances when an appropriate value is not available in the literature.

2.3 TOXICITY EQUIVALENCE FACTORS

One approach used to assess the cancer risk of mixtures of structurally related compounds such as PCBs, dioxins/furans, and PAHs is to characterize the toxicity of these compounds relative to the toxicity of a compound representative of the group. This toxicity equivalence factor (TEF) approach takes into account the differing potencies of carcinogenic compounds from structurally related mixtures (Cal/EPA 1994). The TEF approach is traditionally used in detailed quantitative exposure assessments; however, for this report all toxicity data on these chemicals were obtained from the latest literature sources. No toxicity values were derived.

2.4 LEAD

The traditional RfD approach to toxic chemicals is not applied to lead because most human health effects data are based on blood lead concentrations rather than external dose. Blood lead concentration is an integrated measure of internal dose, reflecting total exposure from site-related and background sources. A clear no-observed-effect concentration has not been established for such lead-related end points as birth weight, gestation period, heme synthesis, and neurobehavioral development in children and fetuses, nor for blood pressure in middle-aged men (ATSDR 1990). Due to these limitations and the uncertainty surrounding the potential impact to adult receptors, this report does not calculate lead exposures and instead defaults to background lead concentrations (see Section 5) for the Parcel A HBRG.

TABLE 2-4
CANCER SLOPE FACTORS

Constituent	Chronic/Subchronic Exposures	
	Oral (mg/kg-d) ⁻¹	Inhalation* (mg/kg-d) ⁻¹
1-butanol	NA	NA
1,1-dichloroethane	5.70E-03	5.70E-03
1,1-dichloroethene	6.00E-01	1.20E+00
1,1,1,2-tetrachloroethane	2.60E-02	2.60E-02
1,1,2-trichloroethane	7.20E-02	7.20E-02
1,1,2,2-tetrachloroethane	2.70E-01	2.70E-01
1,2-dibromo-3-chloropropane	7.00E+00	7.00E+00
1,2-dibromoethane	3.60E+00	2.50E-01
1,2-dichlorobenzene	NA	NA
1,2-dichloroethane	7.00E-02	7.00E-02
1,2-dichloropropane	6.30E-02	6.30E-02
1,2-diphenylhydrazine	8.70E-01	8.70E-01
1,2,3-trichloropropane	7.00E+00	7.00E+00
1,2,4-trichlorobenzene	NA	NA
1,3-dichloropropene	1.80E-01	5.50E-02
1,4-dichlorobenzene	4.00E-02	4.00E-02
2-butanone	NA	NA
2-chlorophenol	NA	NA
2-methylphenol	NA	NA
2-naphthylamine	1.80E+00	1.80E+00
2,4-dichlorophenol	NA	NA
2,4-dimethylphenol	NA	NA
2,4-dinitrophenol	NA	NA
2,4-dinitrotoluene	3.10E-01	3.10E-01
2,4,5-trichlorophenol	NA	NA
2,4,6-trichlorophenol	7.00E-02	7.00E-02
2,6-dinitrotoluene	6.80E-01	6.80E-01
3,3-dichlorobenzidine	1.20E+00	1.20E+00

TABLE 2-4 (CONT.)

Constituent	Chronic/Subchronic Exposures	
	Oral (mg/kg-d) ⁻¹	Inhalation* (mg/kg-d) ⁻¹
4-chloroaniline	NA	NA
4-methyl-2-pentanone	NA	NA
4-methylphenol	NA	NA
4,4-ddd	2.40E-01	2.40E-01
4,4-dde	3.40E-01	3.40E-01
4,4-ddt	3.40E-01	3.40E-01
acenaphthene	NA	NA
acetone	NA	NA
acrolein	NA	NA
acrylonitrile	1.00E+00	1.00E+00
aldrin	1.70E+01	1.70E+01
alpha-bhc	6.30E+00	6.30E+00
aniline	5.70E-03	5.70E-03
anthracene	NA	NA
antimony	NA	NA
aroclor 1016	NA	NA
aroclor 1254	NA	NA
arsenic	1.50E+00	1.20E+01
barium	NA	NA
benzene	1.00E-01	1.00E-01
benzidine	5.00E+02	5.00E+02
benzoic acid	NA	NA
benzo(a)anthracene	1.20E+00	3.90E-01
benzo(a)pyrene	1.20E+01	3.90E+00
benzo(b)fluoranthene	1.20E+00	3.90E-01
benzo(k)fluoranthene	1.20E+00	3.90E-01
benzyl alcohol	NA	NA
benzyl chloride	1.70E-01	1.70E-01
beryllium	NA	8.40E+00
beta-bhc	1.80E+00	1.80E+00

TABLE 2-4 (CONT.)

Constituent	Chronic/Subchronic Exposures	
	Oral (mg/kg-d) ⁻¹	Inhalation* (mg/kg-d) ⁻¹
beta-chloronaphthalene	NA	NA
bis(2-chloro-1-methylethyl)ether	7.00E-02	3.50E-02
bis(2-chloroethyl)ether	2.50E+00	2.50E+00
bis(2-ethylhexyl)phthalate	8.40E-03	8.40E-03
bromodichloromethane	1.30E-01	1.30E-01
bromoform	7.93E-03	3.90E-03
bromomethane	NA	NA
cadmium	NA	1.50E+01
carbazole	2.00E-02	2.00E-02
carbon disulfide	NA	NA
carbon tetrachloride	1.50E-01	1.50E-01
chlordan	1.20E+00	1.20E+00
chlorobenzene	NA	NA
chloroform	3.10E-02	1.90E-02
chloromethane	1.30E-02	6.30E-03
chromium iii	NA	NA
chromium vi	4.20E-01	5.10E+02
chrysene	1.20E-01	3.90E-02
cis-1,2-dichloroethene	NA	NA
copper	NA	NA
cumene	NA	NA
cyanide	NA	NA
dibenzo(a,h)anthracene	4.10E+00	4.10E+00
dibromochloromethane	9.40E-02	9.40E-02
dichlorodifluoromethane	NA	NA
dieldrin	1.60E+01	1.60E+01
diethyl phthalate	NA	NA
di-n-butylphthalate	NA	NA
di-n-octylphthalate	NA	NA
endosulfan	NA	NA
endrin	NA	NA

TABLE 2-4 (CONT.)

Constituent	Chronic/Subchronic Exposures	
	Oral (mg/kg-d) ⁻¹	Inhalation* (mg/kg-d) ⁻¹
ethyl chloride	NA	NA
ethylbenzene	NA	NA
fluoranthene	NA	NA
fluorene	NA	NA
gamma-bhc	1.10E+00	1.10E+00
heptachlor	5.70E+00	5.70E+00
heptachlor epoxide	1.30E+01	1.30E+01
hexachlorobenzene	1.80E+00	1.80E+00
hexachlorobutadiene	7.80E-02	7.80E-02
hexachlorocyclopentadiene	NA	NA
hexachloroethane	3.90E-02	3.90E-02
indeno(1,2,3-cd)pyrene	1.20E+00	3.90E-01
isobutyl alcohol	NA	NA
isophorone	9.50E-04	9.50E-04
mercury	NA	NA
methoxychlor	NA	NA
methyl methacrylate	NA	NA
methylene bromide	NA	NA
methylene chloride	1.40E-02	3.50E-03
methyl-tert-butyl ether	NA	NA
molybdenum	NA	NA
n-butylbenzyl phthalate	NA	NA
nickel	NA	9.10E-01
nitroaniline, o-	NA	NA
nitrobenzene	NA	NA
nitrosodiphenylamine, p-	2.20E-02	2.20E-02
n-nitrosodimethylamine	1.60E+01	1.60E+01
n-nitroso-di-n-propylamine	7.00E+00	7.00E+00
n-nitrosodiphenylamine	9.00E-03	9.00E-03
o-chlorotoluene	NA	NA

TABLE 2-4 (CONT.)

Constituent	Chronic/Subchronic Exposures	
	Oral (mg/kg-d) ⁻¹	Inhalation* (mg/kg-d) ⁻¹
p-chloro-m-cresol	NA	NA
pentachlorophenol	1.80E-02	1.80E-02
phenol	NA	NA
pyrene	NA	NA
selenium	NA	NA
silver	NA	NA
styrene	NA	NA
tetrachloroethene	5.10E-02	2.10E-02
toluene	NA	NA
toxaphene	1.20E+00	1.20E+00
trans-1,2-dichloroethene	NA	NA
trichloroethene	1.50E-02	1.00E-02
trichlorofluoromethane	NA	NA
vanadium	NA	NA
vinyl acetate	NA	NA
vinyl chloride	2.70E-01	2.70E-01
xlenes	NA	NA
zinc	NA	NA

NOTES:

NA = Not Available. No toxicity data exist for pathway.

*Inhalation CSFs equal to oral CSFs when pathway-specific value not available

SOURCES:

California Cancer Potency Factors Update (Cal/EPA 1996)

IRIS (EPA 1997)

HEAST (EPA 1995)

TABLE 2-5
NONCARCINOGENIC DERMAL TOXICITY VALUES

Constituent	GI Absorption	Chronic Exposures		Subchronic Exposures	
		Oral (mg/kg-d)	Dermal (mg/kg-d)	Oral (mg/kg-d)	Dermal (mg/kg-d)
1-butanol	9.00E-01	1.00E-01	9.00E-02	1.00E+00	9.00E-01
1,1-dichloroethane	9.00E-01	1.00E-01	9.00E-02	1.00E+00	9.00E-01
1,1-dichloroethene	9.00E-01	9.00E-03	8.10E-03	9.00E-03	8.10E-03
1,1,1,2-tetrachloroethane	9.00E-01	3.00E-02	2.70E-02	3.00E-02	2.70E-02
1,1,2-trichloroethane	9.00E-01	4.00E-03	3.60E-03	4.00E-02	3.60E-02
1,1,2,2-tetrachloroethane	9.00E-01	NA	NA	NA	NA
1,2-dibromo-3-chloropropane	9.00E-01	NA	NA	NA	NA
1,2-dibromoethane	9.00E-01	NA	NA	NA	NA
1,2-dichlorobenzene	9.00E-01	9.00E-02	8.10E-02	NA	NA
1,2-dichloroethane	9.00E-01	NA	NA	NA	NA
1,2-dichloropropane	9.00E-01	NA	NA	NA	NA
1,2-diphenylhydrazine	9.00E-01	NA	NA	NA	NA
1,2,3-trichloropropane	9.00E-01	6.00E-03	5.40E-03	6.00E-02	5.40E-02
1,2,4-trichlorobenzene	9.00E-01	1.00E-02	9.00E-03	1.00E-02	9.00E-03
1,3-dichloropropene	9.00E-01	3.00E-04	2.70E-04	3.00E-03	2.70E-03
1,4-dichlorobenzene	9.00E-01	NA	NA	NA	NA
2-butanone	9.00E-01	6.00E-01	5.40E-01	2.00E+00	1.80E+00
2-chlorophenol	9.00E-01	5.00E-03	4.50E-03	5.00E-02	4.50E-02
2-methylphenol	9.00E-01	5.00E-02	4.50E-02	5.00E-01	4.50E-01
2-naphthylamine	9.00E-01	NA	NA	NA	NA
2,4-dichlorophenol	9.00E-01	3.00E-03	2.70E-03	3.00E-03	2.70E-03
2,4-dimethylphenol	9.00E-01	2.00E-02	1.80E-02	2.00E-01	1.80E-01
2,4-dinitrophenol	9.00E-01	2.00E-03	1.80E-03	2.00E-03	1.80E-03
2,4-dinitrotoluene	9.00E-01	2.00E-03	1.80E-03	2.00E-03	1.80E-03
2,4,5-trichlorophenol	9.00E-01	1.00E-01	9.00E-02	1.00E+00	9.00E-01
2,4,6-trichlorophenol	9.00E-01	NA	NA	NA	NA
2,6-dinitrotoluene	9.00E-01	1.00E-03	9.00E-04	1.00E-02	9.00E-03
3,3-dichlorobenzidine	9.00E-01	NA	NA	NA	NA

TABLE 2-5 (CONT.)

Constituent	GI Absorption	Chronic Exposures		Subchronic Exposures	
		Oral (mg/kg-d)	Dermal (mg/kg-d)	Oral (mg/kg-d)	Dermal (mg/kg-d)
4-chloroaniline	9.00E-01	4.00E-03	3.60E-03	4.00E-03	3.60E-03
4-methyl-2-pentanone	9.00E-01	8.00E-02	7.20E-02	8.00E-01	7.20E-01
4-methylphenol	9.00E-01	5.00E-03	4.50E-03	5.00E-03	4.50E-03
4,4-ddd	9.00E-01	NA	NA	NA	NA
4,4-dde	9.00E-01	NA	NA	NA	NA
4,4-ddt	9.00E-01	5.00E-04	4.50E-04	5.00E-04	4.50E-04
acenaphthene	9.00E-01	6.00E-02	5.40E-02	6.00E-01	5.40E-01
acetone	9.00E-01	1.00E-01	9.00E-02	1.00E+00	9.00E-01
acrolein	9.00E-01	2.00E-02	1.80E-02	NA	NA
acrylonitrile	9.00E-01	1.00E-03	9.00E-04	1.00E-02	9.00E-03
aldrin	9.00E-01	3.00E-05	2.70E-05	3.00E-05	2.70E-05
alpha-bhc	9.00E-01	NA	NA	NA	NA
aniline	9.00E-01	NA	NA	NA	NA
anthracene	9.00E-01	3.00E-01	2.70E-01	3.00E-01	2.70E-01
antimony	1.50E-01	4.00E-04	6.00E-05	4.00E-04	6.00E-05
aroclor 1016	9.00E-01	7.00E-05	6.30E-05	NA	NA
aroclor 1254	9.00E-01	2.00E-05	1.80E-05	5.00E-05	4.50E-05
arsenic	9.50E-01	3.00E-04	2.85E-04	3.00E-04	2.85E-04
barium	9.10E-01	7.00E-02	6.37E-02	7.00E-02	6.37E-02
benzene	9.00E-01	NA	NA	NA	NA
benzidine	9.00E-01	3.00E-03	2.70E-03	3.00E-03	2.70E-03
benzoic acid	9.00E-01	4.00E+00	3.60E+00	4.00E+00	3.60E+00
benzo(a)anthracene	9.00E-01	NA	NA	NA	NA
benzo(a)pyrene	9.00E-01	NA	NA	NA	NA
benzo(b)fluoranthene	9.00E-01	NA	NA	NA	NA
benzo(k)fluoranthene	9.00E-01	NA	NA	NA	NA
benzyl alcohol	9.00E-01	3.00E-01	2.70E-01	1.00E+00	9.00E-01
benzyl chloride	9.00E-01	NA	NA	NA	NA
beryllium	1.00E-02	5.00E-03	5.00E-05	5.00E-03	5.00E-05
beta-bhc	9.00E-01	NA	NA	NA	NA
beta-chloronaphthalene	9.00E-01	8.00E-02	7.20E-02	NA	0.00E+00

TABLE 2-5 (CONT.)

Constituent	GI Absorption	Chronic Exposures		Subchronic Exposures	
		Oral (mg/kg-d)	Dermal (mg/kg-d)	Oral (mg/kg-d)	Dermal (mg/kg-d)
bis(2-chloro-1-methylethyl)ether	9.00E-01	NA	NA	NA	NA
bis(2-chloroethyl)ether	9.00E-01	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	9.00E-01	2.00E-02	1.80E-02	NA	NA
bromodichloromethane	9.00E-01	2.00E-02	1.80E-02	2.00E-02	1.80E-02
bromoform	9.00E-01	2.00E-02	1.80E-02	2.00E-02	1.80E-02
bromomethane	9.00E-01	1.40E-03	1.26E-03	NA	NA
cadmium	5.00E-02	5.00E-04	2.50E-05	5.00E-04	2.50E-05
carbazole	9.00E-01	NA	NA	NA	NA
carbon disulfide	9.00E-01	1.00E-01	9.00E-02	1.00E-01	9.00E-02
carbon tetrachloride	9.00E-01	7.00E-04	6.30E-04	NA	NA
chlordan	9.00E-01	6.00E-05	5.40E-05	6.00E-05	5.40E-05
chlorobenzene	3.10E-01	2.00E-02	6.20E-03	NA	NA
chloroform	1.00E+00	1.00E-02	1.00E-02	1.00E-02	1.00E-02
chloromethane	9.00E-01	NA	NA	NA	NA
chromium iii	4.50E-01	1.00E+00	4.50E-01	1.00E+00	4.50E-01
chromium vi	4.50E-01	5.00E-03	2.25E-03	2.00E-02	9.00E-03
chrysene	9.00E-01	NA	NA	NA	NA
cis-1,2-dichloroethene	9.00E-01	1.00E-02	9.00E-03	1.00E-01	9.00E-02
copper	6.00E-01	3.70E-02	2.22E-02	3.70E-02	2.22E-02
cumene	9.00E-01	4.00E-02	3.60E-02	4.00E-01	3.60E-01
cyanide	7.20E-01	2.00E-02	1.44E-02	2.00E-02	1.44E-02
dibenzo(a,h)anthracene	9.00E-01	NA	NA	NA	NA
dibromochloromethane	9.00E-01	2.00E-02	1.80E-02	2.00E-01	1.80E-01
dichlorodifluoromethane	9.00E-01	2.00E-01	1.80E-01	9.00E-01	8.10E-01
dieletrin	9.00E-01	5.00E-05	4.50E-05	5.00E-05	4.50E-05
diethyl phthalate	9.00E-01	8.00E-01	7.20E-01	8.00E+00	7.20E+00
di-n-butylphthalate	9.00E-01	1.00E-01	9.00E-02	1.00E+00	9.00E-01
di-n-octylphthalate	9.00E-01	2.00E-02	1.80E-02	2.00E-02	1.80E-02
endosulfan	9.00E-01	6.00E-03	5.40E-03	6.00E-03	5.40E-03
endrin	9.00E-01	3.00E-04	2.70E-04	3.00E-04	2.70E-04

TABLE 2-5 (CONT.)

Constituent	GI Absorption	Chronic Exposures		Subchronic Exposures	
		Oral (mg/kg-d)	Dermal (mg/kg-d)	Oral (mg/kg-d)	Dermal (mg/kg-d)
ethyl chloride	9.00E-01	NA	NA	NA	NA
ethylbenzene	9.20E-01	1.00E-01	9.20E-02	NA	NA
fluoranthene	9.00E-01	4.00E-02	3.60E-02	4.00E-01	3.60E-01
fluorene	9.00E-01	4.00E-02	3.60E-02	4.00E-01	3.60E-01
gamma-bhc	9.80E-01	3.00E-04	2.94E-04	3.00E-03	2.94E-03
heptachlor	4.00E-01	5.00E-04	2.00E-04	5.00E-04	2.00E-04
heptachlor epoxide	9.00E-01	1.30E-05	1.17E-05	1.30E-05	1.17E-05
hexachlorobenzene	9.00E-01	8.00E-04	7.20E-04	NA	NA
hexachlorobutadiene	9.00E-01	2.00E-04	1.80E-04	NA	NA
hexachlorocyclopentadiene	9.00E-01	7.00E-03	6.30E-03	7.00E-02	6.30E-02
hexachloroethane	9.00E-01	1.00E-03	9.00E-04	1.00E-02	9.00E-03
indeno(1,2,3-cd)pyrene	9.00E-01	NA	NA	NA	NA
isobutyl alcohol	9.00E-01	3.00E-01	2.70E-01	3.00E+00	2.70E+00
isophorone	9.00E-01	2.00E-01	1.80E-01	2.00E+00	1.80E+00
mercury	1.50E-01	3.00E-04	4.50E-05	3.00E-04	4.50E-05
methoxychlor	9.00E-01	5.00E-03	4.50E-03	5.00E-03	4.50E-03
methyl methacrylate	9.00E-01	8.00E-02	7.20E-02	8.00E-02	7.20E-02
methylene bromide	9.00E-01	1.00E-02	9.00E-03	1.00E-01	9.00E-02
methylene chloride	1.00E+00	6.00E-02	6.00E-02	6.00E-02	6.00E-02
methyl-tert-butyl ether	9.00E-01	NA	NA	NA	NA
molybdenum	3.80E-01	5.00E-03	1.90E-03	4.00E-02	1.52E-02
n-butylbenzyl phthalate	9.00E-01	2.00E-01	1.80E-01	2.00E-01	1.80E-01
nickel	5.00E-02	2.00E-02	1.00E-03	2.00E-02	1.00E-03
nitroaniline, o-	9.00E-01	NA	NA	NA	NA
nitrobenzene	9.00E-01	5.00E-04	4.50E-04	5.00E-03	4.50E-03
nitrosodiphenylamine, p-	9.00E-01	NA	NA	NA	NA
n-nitrosodimethylamine	9.00E-01	NA	NA	NA	NA
n-nitroso-di-n-propylamine	9.00E-01	NA	NA	NA	NA
n-nitrosodiphenylamine	9.00E-01	NA	NA	NA	NA
o-chlorotoluene	9.00E-01	2.00E-02	1.80E-02	2.00E-01	1.80E-01
p-chloro-m-cresol	9.00E-01	NA	0.00E+00	2.00E+00	1.80E+00

TABLE 2-5 (CONT.)

Constituent	Chronic Exposures		Subchronic Exposures	
	GI Absorption	Oral (mg/kg-d)	Dermal (mg/kg-d)	Oral (mg/kg-d)
pentachlorophenol	1.00E+00	3.00E-02	3.00E-02	3.00E-02
phenol	9.00E-01	6.00E-01	5.40E-01	6.00E-01
pyrene	4.30E-01	3.00E-02	1.29E-02	3.00E-01
selenium	9.70E-01	5.00E-03	4.85E-03	5.00E-03
silver	2.10E-01	5.00E-03	1.05E-03	5.00E-03
styrene	9.00E-01	2.00E-01	1.80E-01	NA
tetrachloroethene	9.00E-01	1.00E-02	9.00E-03	1.00E-01
toluene	1.00E+00	2.00E-01	2.00E-01	2.00E+00
toxaphene	9.00E-01	NA	NA	NA
trans-1,2-dichloroethene	9.00E-01	2.00E-02	1.80E-02	2.00E-01
trichloroethene	9.80E-01	NA	NA	NA
trichlorofluoromethane	9.00E-01	3.00E-01	2.70E-01	7.00E-01
vanadium	5.00E-02	7.00E-03	3.50E-04	7.00E-03
vinyl acetate	9.00E-01	1.00E+00	9.00E-01	1.00E+00
vinyl chloride	9.00E-01	NA	NA	NA
xylenes	9.00E-01	2.00E+00	1.80E+00	2.00E+00
zinc	3.00E-01	3.00E-01	9.00E-02	3.00E-01
				9.00E-02

NOTES:

NA = Not Available. No toxicity data exist for pathway.

SOURCES:

Dermal Exposure Assessment (EPA 1992)
 California Cancer Potency Factors Update (Cal/EPA 1996)
 IRIS (EPA 1997)
 HEAST (EPA 1995)

TABLE 2-6
CARCINOGENIC DERMAL TOXICITY VALUES

Constituent	Chronic/Subchronic Exposures		
	GI Absorption	Oral (mg/kg-d) ⁻¹	Dermal (mg/kg-d) ⁻¹
1-butanol	9.00E-01	NA	NA
1,1-dichloroethane	9.00E-01	5.70E-03	5.70E-03
1,1-dichloroethene	9.00E-01	6.00E-01	1.20E+00
1,1,1,2-tetrachloroethane	9.00E-01	2.60E-02	2.60E-02
1,1,2-trichloroethane	9.00E-01	7.20E-02	7.20E-02
1,1,2,2-tetrachloroethane	9.00E-01	2.70E-01	2.70E-01
1,2-dibromo-3-chloropropane	9.00E-01	7.00E+00	7.00E+00
1,2-dibromoethane	9.00E-01	3.60E+00	2.50E-01
1,2-dichlorobenzene	9.00E-01	NA	NA
1,2-dichloroethane	9.00E-01	7.00E-02	7.00E-02
1,2-dichloropropane	9.00E-01	6.30E-02	6.30E-02
1,2-diphenylhydrazine	9.00E-01	8.70E-01	8.70E-01
1,2,3-trichloropropane	9.00E-01	7.00E+00	7.00E+00
1,2,4-trichlorobenzene	9.00E-01	NA	NA
1,3-dichloropropene	9.00E-01	1.80E-01	5.50E-02
1,4-dichlorobenzene	9.00E-01	4.00E-02	4.00E-02
2-butanone	9.00E-01	NA	NA
2-chlorophenol	9.00E-01	NA	NA
2-methylphenol	9.00E-01	NA	NA
2-naphthylamine	9.00E-01	1.80E+00	1.80E+00
2,4-dichlorophenol	9.00E-01	NA	NA
2,4-dimethylphenol	9.00E-01	NA	NA
2,4-dinitrophenol	9.00E-01	NA	NA
2,4-dinitrotoluene	9.00E-01	3.10E-01	3.10E-01
2,4,5-trichlorophenol	9.00E-01	NA	NA
2,4,6-trichlorophenol	9.00E-01	7.00E-02	7.00E-02
2,6-dinitrotoluene	9.00E-01	6.80E-01	6.80E-01
3,3-dichlorobenzidine	9.00E-01	1.20E+00	1.20E+00
4-chloroaniline	9.00E-01	NA	NA

TABLE 2-6 (CONT.)

Constituent	Chronic/Subchronic Exposures		
	GI Absorption	Oral (mg/kg-d) ⁻¹	Dermal (mg/kg-d) ⁻¹
4-methyl-2-pentanone	9.00E-01	NA	NA
4-methylphenol	9.00E-01	NA	NA
4,4-ddd	9.00E-01	2.40E-01	2.40E-01
4,4-dde	9.00E-01	3.40E-01	3.40E-01
4,4-ddt	9.00E-01	3.40E-01	3.40E-01
acenaphthene	9.00E-01	NA	NA
acetone	9.00E-01	NA	NA
acrolein	9.00E-01	NA	NA
acrylonitrile	9.00E-01	1.00E+00	1.00E+00
aldrin	9.00E-01	1.70E+01	1.70E+01
alpha-bhc	9.00E-01	6.30E+00	6.30E+00
aniline	9.00E-01	5.70E-03	5.70E-03
anthracene	9.00E-01	NA	NA
antimony	1.50E-01	NA	NA
aroclor 1016	9.00E-01	NA	NA
aroclor 1254	9.00E-01	NA	NA
arsenic	9.50E-01	1.50E+00	1.20E+01
barium	9.10E-01	NA	NA
benzene	9.00E-01	1.00E-01	1.00E-01
benzidine	9.00E-01	5.00E+02	5.00E+02
benzoic acid	9.00E-01	NA	NA
benzo(a)anthracene	9.00E-01	1.20E+00	3.90E-01
benzo(a)pyrene	9.00E-01	1.20E+01	3.90E+00
benzo(b)fluoranthene	9.00E-01	1.20E+00	3.90E-01
benzo(k)fluoranthene	9.00E-01	1.20E+00	3.90E-01
benzyl alcohol	9.00E-01	NA	NA
benzyl chloride	9.00E-01	1.70E-01	1.70E-01
beryllium	1.00E-02	NA	8.40E+00
beta-bhc	9.00E-01	1.80E+00	1.80E+00
beta-chloronaphthalene	9.00E-01	NA	NA
bis(2-chloro-1-methylethyl)ether	9.00E-01	7.00E-02	3.50E-02

TABLE 2-6 (CONT.)

Constituent	GI Absorption	Chronic/Subchronic Exposures	
		Oral (mg/kg-d) ⁻¹	Dermal (mg/kg-d) ⁻¹
bis(2-chloroethyl)ether	9.00E-01	2.50E+00	2.50E+00
bis(2-ethylhexyl)phthalate	9.00E-01	8.40E-03	8.40E-03
bromodichloromethane	9.00E-01	1.30E-01	1.30E-01
bromoform	9.00E-01	7.93E-03	3.90E-03
bromomethane	9.00E-01	NA	NA
cadmium	5.00E-02	NA	1.50E+01
carbazole	9.00E-01	2.00E-02	2.00E-02
carbon disulfide	9.00E-01	NA	NA
carbon tetrachloride	9.00E-01	1.50E-01	1.50E-01
chlordan	9.00E-01	1.20E+00	1.20E+00
chlorobenzene	3.10E-01	NA	NA
chloroform	1.00E+00	3.10E-02	1.90E-02
chloromethane	9.00E-01	1.30E-02	6.30E-03
chromium iii	4.50E-01	NA	NA
chromium vi	4.50E-01	4.20E-01	5.10E+02
chrysene	9.00E-01	1.20E-01	3.90E-02
cis-1,2-dichloroethene	9.00E-01	NA	NA
copper	6.00E-01	NA	NA
cumene	9.00E-01	NA	NA
cyanide	7.20E-01	NA	NA
dibenzo(a,h)anthracene	9.00E-01	4.10E+00	4.10E+00
dibromochloromethane	9.00E-01	9.40E-02	9.40E-02
dichlorodifluoromethane	9.00E-01	NA	NA
dieldrin	9.00E-01	1.60E+01	1.60E+01
diethyl phthalate	9.00E-01	NA	NA
di-n-butylphthalate	9.00E-01	NA	NA
di-n-octylphthalate	9.00E-01	NA	NA
endosulfan	9.00E-01	NA	NA
endrin	9.00E-01	NA	NA
ethyl chloride	9.00E-01	NA	NA
ethylbenzene	9.20E-01	NA	NA

TABLE 2-6 (CONT.)

Constituent	Chronic/Subchronic Exposures		
	GI Absorption	Oral (mg/kg-d) ⁻¹	Dermal (mg/kg-d) ⁻¹
fluoranthene	9.00E-01	NA	NA
fluorene	9.00E-01	NA	NA
gamma-bhc	9.80E-01	1.10E+00	1.10E+00
heptachlor	4.00E-01	5.70E+00	5.70E+00
heptachlor epoxide	9.00E-01	1.30E+01	1.30E+01
hexachlorobenzene	9.00E-01	1.80E+00	1.80E+00
hexachlorobutadiene	9.00E-01	7.80E-02	7.80E-02
hexachlorocyclopentadiene	9.00E-01	NA	NA
hexachloroethane	9.00E-01	3.90E-02	3.90E-02
indeno(1,2,3-cd)pyrene	9.00E-01	1.20E+00	3.90E-01
isobutyl alcohol	9.00E-01	NA	NA
isophorone	9.00E-01	9.50E-04	9.50E-04
mercury	1.50E-01	NA	NA
methoxychlor	9.00E-01	NA	NA
methyl methacrylate	9.00E-01	NA	NA
methylene bromide	9.00E-01	NA	NA
methylene chloride	1.00E+00	1.40E-02	3.50E-03
methyl-tert-butyl ether	9.00E-01	NA	NA
molybdenum	3.80E-01	NA	NA
n-butylbenzyl phthalate	9.00E-01	NA	NA
nickel	5.00E-02	NA	9.10E-01
nitroaniline, o-	9.00E-01	NA	NA
nitrobenzene	9.00E-01	NA	NA
nitrosodiphenylamine, p-	9.00E-01	2.20E-02	2.20E-02
n-nitrosodimethylamine	9.00E-01	1.60E+01	1.60E+01
n-nitroso-di-n-propylamine	9.00E-01	7.00E+00	7.00E+00
n-nitrosodiphenylamine	9.00E-01	9.00E-03	9.00E-03
o-chlorotoluene	9.00E-01	NA	NA
p-chloro-m-cresol	9.00E-01	NA	NA
pentachlorophenol	1.00E+00	1.80E-02	1.80E-02
phenol	9.00E-01	NA	NA

TABLE 5-2 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
3,3-dichlorobenzidine	NA	7.53E+08	7.53E+08
4-chloroaniline	6.50E+06	NA	6.50E+06
4-methyl-2-pentanone	6.84E+05	NA	6.84E+05
4-methylphenol	4.01E+07	NA	4.01E+07
4,4-ddd	NA	9.97E+08	9.97E+08
4,4-dde	NA	2.83E+06	2.83E+06
4,4-ddt	2.75E+09	2.26E+08	2.26E+08
acenaphthene	1.62E+08	NA	1.62E+08
acetone	4.37E+05	NA	4.37E+05
acrolein	8.05E+01	NA	8.05E+01
acrylonitrile	3.12E+03	7.65E+01	7.65E+01
aldrin	1.03E+06	2.82E+04	2.82E+04
alpha-bhc	NA	2.32E+05	2.32E+05
aniline	1.02E+07	8.77E+07	1.02E+07
anthracene	1.37E+10	NA	1.37E+10
antimony	NA	NA	NA
aroclor 1016	7.35E+05	NA	7.35E+05
aroclor 1254	5.69E+05	NA	5.69E+05
arsenic	NA	NA	NA
barium	NA	NA	NA
benzene	NA	1.71E+02	1.71E+02
benzidine	1.66E+07	1.55E+02	1.55E+02
benzoic acid	6.58E+10	NA	6.58E+10
benzo(a)anthracene	NA	1.13E+09	1.13E+09
benzo(a)pyrene	NA	9.56E+07	9.56E+07
benzo(b)fluoranthene	NA	3.19E+08	3.19E+08
benzo(k)fluoranthene	NA	9.56E+07	9.56E+07
benzyl alcohol	3.81E+08	NA	3.81E+08
benzyl chloride	NA	4.03E+03	4.03E+03
beryllium	NA	NA	NA
beta-bhc.	NA	9.94E+06	9.94E+06

TABLE 5-2 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
beta-chloronaphthalene	2.32E+07	NA	2.32E+07
bis(2-chloro-1-methylethyl)ether	NA	2.93E+04	2.93E+04
bis(2-chloroethyl)ether	NA	6.91E+02	6.91E+02
bis(2-ethylhexyl)phthalate	4.30E+10	3.59E+09	3.59E+09
bromodichloromethane	5.47E+05	2.94E+03	2.94E+03
bromoform	7.13E+05	1.28E+05	1.28E+05
bromomethane	1.15E+02	NA	1.15E+02
cadmium	NA	NA	NA
carbazole	NA	6.66E+08	6.66E+08
carbon disulfide	7.04E+04	NA	7.04E+04
carbon tetrachloride	1.01E+03	1.35E+02	1.35E+02
chlordan	7.96E+05	1.55E+05	1.55E+05
chlorobenzene	2.83E+04	NA	2.83E+04
chloroform	1.30E+04	9.58E+02	9.58E+02
chloromethane	NA	7.40E+01	7.40E+01
chromium iii	NA	NA	NA
chromium vi	NA	NA	NA
chrysene	NA	5.06E+10	5.06E+10
cis-1,2-dichloroethene	7.51E+03	NA	7.51E+03
copper	NA	NA	NA
cumene	5.73E+04	NA	5.73E+04
cyanide	NA	NA	NA
dibenzo(a,h)anthracene	NA	6.34E+11	6.34E+11
dibromochloromethane	2.06E+04	1.54E+02	1.54E+02
dichlorodifluoromethane	7.01E+02	NA	7.01E+02
ieldrin	1.33E+06	2.33E+04	2.33E+04
diethyl phthalate	6.03E+09	NA	6.03E+09
di-n-butylphthalate	4.19E+08	NA	4.19E+08
di-n-octylphthalate	1.80E+10	NA	1.80E+10
endosulfan	2.14E+08	NA	2.14E+08
endrin	1.37E+08	NA	1.37E+08

TABLE 5-2 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
ethyl chloride	1.57E+06	NA	1.57E+06
ethylbenzene	7.33E+05	NA	7.33E+05
fluoranthene	3.03E+10	NA	3.03E+10
fluorene	1.40E+08	NA	1.40E+08
gamma-bhc	6.20E+06	2.63E+05	2.63E+05
heptachlor	3.62E+05	1.78E+03	1.78E+03
heptachlor epoxide	1.63E+04	1.35E+03	1.35E+03
hexachlorobenzene	2.88E+05	2.80E+03	2.80E+03
hexachlorobutadiene	7.95E+04	7.13E+04	7.13E+04
hexachlorocyclopentadiene	9.79E+02	NA	9.79E+02
hexachloroethane	6.65E+05	2.39E+05	2.39E+05
indeno(1,2,3-cd)pyrene	NA	1.23E+11	1.23E+11
isobutyl alcohol	2.55E+06	NA	2.55E+06
isophorone	3.97E+08	2.92E+07	2.92E+07
mercury	NA	NA	NA
methoxychlor	1.48E+09	NA	1.48E+09
methyl methacrylate	5.56E+04	NA	5.56E+04
methylene bromide	2.75E+04	NA	2.75E+04
methylene chloride	2.71E+05	1.26E+03	1.26E+03
methyl-tert-butyl ether	1.39E+06	NA	1.39E+06
molybdenum	NA	NA	NA
n-butylbenzyl phthalate	6.52E+09	NA	6.52E+09
nickel	NA	NA	NA
nitroaniline, o-	2.45E+06	NA	2.45E+06
nitrobenzene	1.78E+05	NA	1.78E+05
nitrosodiphenylamine, p-	NA	1.03E+07	1.03E+07
n-nitrosodimethylamine	NA	1.38E-02	1.38E-02
n-nitroso-di-n-propylamine	NA	4.46E+02	4.46E+02
n-nitrosodiphenylamine	NA	4.80E+09	4.80E+09
o-chlorotoluene	1.05E+05	NA	1.05E+05
p-chloro-m-cresol	NA	NA	NA

TABLE 5-2 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
pentachlorophenol	1.19E+09	3.09E+07	3.09E+07
phenol	3.14E+09	NA	3.14E+09
pyrene	4.11E+10	NA	4.11E+10
selenium	NA	NA	NA
silver	NA	NA	NA
styrene	7.58E+06	NA	7.58E+06
tetrachloroethene	1.13E+05	7.52E+03	7.52E+03
toluene	2.41E+05	NA	2.41E+05
toxaphene	NA	9.16E+04	9.16E+04
trans-1,2-dichloroethene	1.47E+04	NA	1.47E+04
trichloroethene	NA	1.39E+03	1.39E+03
trichlorofluoromethane	4.89E+04	NA	4.89E+04
vanadium	NA	NA	NA
vinyl acetate	2.31E+05	NA	2.31E+05
vinyl chloride	NA	1.81E-01	1.81E-01
xlenes	2.61E+07	NA	2.61E+07
zinc	NA	NA	NA

NOTES:

NA = Not Available. No toxicity data.

TABLE 5-3
FINAL HEALTH-BASED REMEDIATION GOALS (HBRGs)
FOR ORGANIC CONSTITUENTS,
SOIL EXPOSURE PATHWAYS (mg/kg)

Constituent	Construction Worker Initial HBRG	Commercial/ Industrial User Initial HBRG	Final HBRG
1-butanol	1.98E+04	3.46E+04	1.98E+04
1,1-dichloroethane	2.23E+03	1.10E+03	1.10E+03
1,1-dichloroethene	1.57E+01	4.21E+00	4.21E+00
1,1,1,2-tetrachloroethane	4.98E+02	1.44E+04	4.98E+02
1,1,2-trichloroethane	2.23E+02	1.26E+03	2.23E+02
1,1,2,2-tetrachloroethane	6.25E+01	1.50E+03	6.25E+01
1,2-dibromo-3-chloropropane	2.42E+00	7.47E+01	2.42E+00
1,2-dibromoethane	4.86E+00	1.84E+02	4.86E+00
1,2-dichlorobenzene	NA	2.64E+06	2.64E+06
1,2-dichloroethane	2.06E+02	2.66E+02	2.06E+02
1,2-dichloropropane	3.37E+01	7.25E+00	7.25E+00
1,2-diphenylhydrazine	2.03E+01	2.36E+08	2.03E+01
1,2,3-trichloropropane	2.39E+00	4.08E+01	2.39E+00
1,2,4-trichlorobenzene	1.74E+02	4.74E+07	1.74E+02
1,3-dichloropropene	4.83E+01	6.63E+02	4.83E+01
1,4-dichlorobenzene	4.32E+02	4.37E+04	4.32E+02
2-butanone	3.28E+04	2.35E+06	3.28E+04
2-chlorophenol	8.57E+02	1.17E+06	8.57E+02
2-methylphenol	8.66E+03	7.59E+07	8.66E+03
2-naphthylamine	9.81E+00	1.63E+06	9.81E+00
2,4-dichlorophenol	5.21E+01	2.22E+07	5.21E+01
2,4-dimethylphenol	3.48E+03	4.37E+08	3.48E+03
2,4-dinitrophenol	3.49E+01	7.14E+09	3.49E+01
2,4-dinitrotoluene	3.48E+01	7.62E+06	3.48E+01
2,4,5-trichlorophenol	1.73E+04	2.21E+08	1.73E+04
2,4,6-trichlorophenol	2.52E+02	1.10E+07	2.52E+02
2,6-dinitrotoluene	2.59E+01	4.51E+05	2.59E+01
3,3-dichlorobenzidine	1.47E+01	7.53E+08	1.47E+01

TABLE 5-3 (CONT.)

Constituent	Construction Worker Initial HBRG	Commercial/ Industrial User Initial HBRG	Final HBRG
4-chloroaniline	6.93E+01	6.50E+06	6.93E+01
4-methyl-2-pentanone	1.20E+04	6.84E+05	1.20E+04
4-methylphenol	8.69E+01	4.01E+07	8.69E+01
4,4-ddd	1.03E+02	9.97E+08	1.03E+02
4,4-dde	7.28E+01	2.83E+06	7.28E+01
4,4-ddt	1.22E+01	2.26E+08	1.22E+01
acenaphthene	8.10E+03	1.62E+08	8.10E+03
acetone	1.55E+04	4.37E+05	1.55E+04
acrolein	NA	8.05E+01	8.05E+01
acrylonitrile	1.59E+01	7.65E+01	1.59E+01
aldrin	7.32E-01	2.82E+04	7.32E-01
alpha-bhc	3.93E+00	2.32E+05	3.93E+00
aniline	3.10E+03	1.02E+07	3.10E+03
anthracene	4.06E+03	1.37E+10	4.06E+03
aroclor 1016	NA	7.35E+05	7.35E+05
aroclor 1254	8.70E-01	5.69E+05	8.70E-01
benzene	1.43E+02	1.71E+02	1.43E+02
benzidine	3.52E-02	1.55E+02	3.52E-02
benzoic acid	6.96E+04	6.58E+10	6.96E+04
benzo(a)anthracene	1.14E+01	1.13E+09	1.14E+01
benzo(a)pyrene	1.14E+00	9.56E+07	1.14E+00
benzo(b)fluoranthene	1.14E+01	3.19E+08	1.14E+01
benzo(k)fluoranthene	1.14E+01	9.56E+07	1.14E+01
benzyl alcohol	1.73E+04	3.81E+08	1.73E+04
benzyl chloride	1.00E+02	4.03E+03	1.00E+02
beta-bhc	1.38E+01	9.94E+06	1.38E+01
beta-chloronaphthalene	NA	2.32E+07	2.32E+07
bis(2-chloro-1-methylethyl)ether	2.49E+02	2.93E+04	2.49E+02
bis(2-chloroethyl)ether	6.91E+00	6.91E+02	6.91E+00
bis(2-ethylhexyl)phthalate	2.10E+03	3.59E+09	2.10E+03
bromodichloromethane	1.30E+02	2.94E+03	1.30E+02

TABLE 5-3 (CONT.)

Constituent	Construction Worker Initial HBRG	Commercial/ Industrial User Initial HBRG	Final HBRG
bromoform	3.34E+02	1.28E+05	3.34E+02
bromomethane	NA	1.15E+02	1.15E+02
carbazole	8.83E+02	6.66E+08	8.83E+02
carbon disulfide	1.43E+03	7.04E+04	1.43E+03
carbon tetrachloride	9.71E+01	1.35E+02	9.71E+01
chlordan	1.04E+00	1.55E+05	1.04E+00
chlorobenzene	NA	2.83E+04	2.83E+04
chloroform	1.49E+02	9.58E+02	1.49E+02
chloromethane	7.43E+02	7.40E+01	7.40E+01
chrysene	1.14E+02	5.06E+10	1.14E+02
cis-1,2-dichloroethene	1.34E+03	7.51E+03	1.34E+03
cumene	3.79E+03	5.73E+04	3.79E+03
dibenzo(a,h)anthracene	3.35E+00	6.34E+11	3.35E+00
dibromochloromethane	1.50E+02	1.54E+02	1.50E+02
dichlorodifluoromethane	2.14E+03	7.01E+02	7.01E+02
dieldrin	1.22E+00	2.33E+04	1.22E+00
diethyl phthalate	1.39E+05	6.03E+09	1.39E+05
di-n-butylphthalate	1.74E+04	4.19E+08	1.74E+04
di-n-octylphthalate	3.49E+02	1.80E+10	3.49E+02
endosulfan	1.46E+02	2.14E+08	1.46E+02
endrin	7.33E+00	1.37E+08	7.33E+00
ethyl chloride	1.42E+05	1.57E+06	1.42E+05
ethylbenzene	NA	7.33E+05	7.33E+05
fluoranthene	6.97E+03	3.03E+10	6.97E+03
fluorene	6.94E+03	1.40E+08	6.94E+03
gamma-bhc	2.32E+01	2.63E+05	2.32E+01
heptachlor	2.87E+00	1.78E+03	2.87E+00
heptachlor epoxide	3.14E-01	1.35E+03	3.14E-01
hexachlorobenzene	9.69E+00	2.80E+03	9.69E+00
hexachlorobutadiene	2.24E+02	7.13E+04	2.24E+02
hexachlorocyclopentadiene	8.87E+01	9.79E+02	8.87E+01

TABLE 5-3 (CONT.)

Constituent	Construction Worker Initial HBRG	Commercial/ Industrial User Initial HBRG	Final HBRG
hexachloroethane	1.73E+02	2.39E+05	1.73E+02
indeno(1,2,3-cd)pyrene	1.47E+01	1.23E+11	1.47E+01
isobutyl alcohol	4.81E+04	2.55E+06	4.81E+04
isophorone	1.85E+04	2.92E+07	1.85E+04
methoxychlor	8.71E+01	1.48E+09	8.71E+01
methyl methacrylate	1.06E+03	5.56E+04	1.06E+03
methylene bromide	1.51E+03	2.75E+04	1.51E+03
methylene chloride	1.07E+03	1.26E+03	1.07E+03
methyl-tert-butyl ether	NA	1.39E+06	1.39E+06
n-butylbenzyl phthalate	3.48E+03	6.52E+09	3.48E+03
nitroaniline, o-	8.07E+03	2.45E+06	8.07E+03
nitrobenzene	8.61E+01	1.78E+05	8.61E+01
nitrosodiphenylamine, p-	8.02E+02	1.03E+07	8.02E+02
n-nitrosodimethylamine	2.60E-01	1.38E-02	1.38E-02
n-nitroso-di-n-propylamine	2.48E+00	4.46E+02	2.48E+00
n-nitrosodiphenylamine	1.96E+03	4.80E+09	1.96E+03
o-chlorotoluene	3.14E+03	1.05E+05	3.14E+03
p-chloro-m-cresol	3.48E+04	NA	3.48E+04
pentachlorophenol	3.04E+02	3.09E+07	3.04E+02
phenol	1.04E+04	3.14E+09	1.04E+04
pyrene	2.35E+03	4.11E+10	2.35E+03
styrene	3.02E+05	7.58E+06	3.02E+05
tetrachloroethene	3.36E+02	7.52E+03	3.36E+02
toluene	3.12E+04	2.41E+05	3.12E+04
toxaphene	1.47E+01	9.16E+04	1.47E+01
trans-1,2-dichloroethene	2.68E+03	1.47E+04	2.68E+03
trichloroethene	1.05E+03	1.39E+03	1.05E+03
trichlorofluoromethane	1.03E+04	4.89E+04	1.03E+04
vinyl acetate	5.41E+03	2.31E+05	5.41E+03
vinyl chloride	5.16E+00	1.81E-01	1.81E-01
xylenes	3.26E+04	2.61E+07	3.26E+04

NOTES: NA = Not Available.

TABLE 5-4
FINAL HEALTH-BASED REMEDIATION GOALS (HBRGs)
FOR INORGANIC COMPOUNDS,
SOIL EXPOSURE PATHWAYS (mg/kg)

Compound	Initial HBRG	ILM Background*	Final HBRG
aluminum	NT	3.63E+04	3.63E+04
antimony	9.05E+00	5.00E+00	9.05E+00
arsenic	8.87E+00	1.40E+01	1.40E+01
barium	2.52E+03	2.81E+02	2.52E+03
beryllium	1.56E+01	7.40E-01	1.56E+01
cadmium	1.64E+01	8.80E-01	1.64E+01
calcium	NT	3.80E+04	3.80E+04
chromium iii	3.22E+04	4.10E+01	3.22E+04
chromium vi	9.73E+01	NA	9.73E+01
cobalt	NT	2.00E+01	2.00E+01
copper	1.26E+03	5.30E+01	1.26E+03
cyanide	6.99E+02	NA	6.99E+02
iron	NT	6.05E+04	6.05E+04
lead	NT	1.11E+02	1.11E+02
mercury	6.78E+00	2.80E-01	6.78E+00
molybdenum	1.24E+03	2.30E+01	1.24E+03
nickel	2.39E+02	2.90E+01	2.39E+02
potassium	NT	8.26E+03	8.26E+03
selenium	1.82E+02	1.24E+03	1.24E+03
silver	1.30E+02	2.39E+02	2.39E+02
sodium	NT	1.96E+03	1.96E+03
thallium	NT	1.10E+01	1.10E+01
titanium	NT	1.95E+03	1.95E+03
vanadium	8.37E+01	8.20E+01	8.37E+01
zinc	8.73E+03	1.98E+02	8.73E+03

NOTES:

*ILM background values provided in Baseline Risk Assessment (G&M 1996). See Appendix E.
 NT = No Toxicity values available for calculation of HBRG
 NA = Not Available.

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Appendix A

Table A-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Intake Equation = $CS \times EF \times ED \times CF \times IR$
 $BW \times AT$

IRs	Ingestion rate of soil (RAGS, 1989)	480 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	90 d/year
EDn	Exposure duration for non-carcinogens	1 year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 day
ATn	Average time for non-carcinogens (EDn x 365)	126 day (see table below)
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	Concentration	Concentration
1-butanol	1.0E+00	2-butanone
1,1-dichloroethane	1.0E+00	2-chlorophenol
1,1-dichloroethene	1.0E+00	2-methylphenol
1,1,1,2-tetrachloroethane	1.0E+00	2-naphthylamine
1,1,2-trichloroethane	1.0E+00	2,4-dichlorophenol
1,1,2,2-tetrachloroethane	1.0E+00	2,4-dimethylphenol
1,2-dibromo-3-chloropropane	1.0E+00	2,4-dinitrophenol
1,2-dibromoethane	1.0E+00	2,4-dinitrotoluene
1,2-dichlorobenzene	1.0E+00	2,4,5-trichlorophenol
1,2-dichloroethane	1.0E+00	2,4,6-trichlorophenol
1,2-dichloropropane	1.0E+00	2,6-dinitrotoluene
1,2-diphenylhydrazine	1.0E+00	3,3-dichlorobenzidine
1,2,3-trichloropropane	1.0E+00	4-chloroaniline
1,2,4-trichlorobenzene	1.0E+00	4-methyl-2-pentanone
1,3-dichloropropene	1.0E+00	
1,4-dichlorobenzene	1.0E+00	

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
1-butanol	4.90E-06	1.00E+00	4.90E-06	2.42E-08	NA	NA
1,1-dichloroethane	4.90E-06	1.00E+00	4.90E-06	2.42E-08	5.70E-03	1.38E-10
1,1-dichloroethene	4.90E-06	9.00E-03	5.44E-04	2.42E-08	6.00E-01	1.45E-08
1,1,1,2-tetrachloroethane	4.90E-06	3.00E-02	1.63E-04	2.42E-08	2.60E-02	6.28E-10
1,1,2-trichloroethane	4.90E-06	4.00E-02	1.22E-04	2.42E-08	7.20E-02	1.74E-09
1,1,2,2-tetrachloroethane	4.90E-06	NA	NA	2.42E-08	2.70E-01	6.52E-09
1,2-dibromo-3-chloropropane	4.90E-06	NA	NA	2.42E-08	7.00E+00	1.69E-07
1,2-dibromoethane	4.90E-06	NA	NA	2.42E-08	3.60E+00	8.70E-08
1,2-dichlorobenzene	4.90E-06	NA	NA	2.42E-08	NA	NA
1,2-dichloroethane	4.90E-06	NA	NA	2.42E-08	7.00E-02	1.69E-09
1,2-dichloropropane	4.90E-06	NA	NA	2.42E-08	6.30E-02	1.52E-09
1,2-diphenylhydrazine	4.90E-06	NA	NA	2.42E-08	8.70E-01	2.10E-08
1,2,3-trichloropropane	4.90E-06	6.00E-02	8.16E-05	2.42E-08	7.00E+00	1.69E-07
1,2,4-trichlorobenzene	4.90E-06	1.00E-02	4.90E-04	2.42E-08	NA	NA
1,3-dichloropropene	4.90E-06	3.00E-03	1.63E-03	1,3-dichloropropene	2.42E-08	1.80E-01
1,4-dichlorobenzene	4.90E-06	NA	NA	1,4-dichlorobenzene	2.42E-08	4.00E-02
2-butanone	4.90E-06	2.00E+00	2.45E-06	2-butanone	2.42E-08	NA
2-chlorophenol	4.90E-06	5.00E-02	9.80E-05	2-chlorophenol	2.42E-08	NA
2-methylphenol	4.90E-06	5.00E-01	9.80E-06	2-methylphenol	2.42E-08	NA
2-naphthylamine	4.90E-06	NA	NA	2-naphthylamine	2.42E-08	1.80E+00
2,4-dichlorophenol	4.90E-06	3.00E-03	1.63E-03	2,4-dichlorophenol	2.42E-08	NA
2,4-dimethylphenol	4.90E-06	2.00E-01	2.45E-05	2,4-dimethylphenol	2.42E-08	NA
2,4-dinitrophenol	4.90E-06	2.00E-03	2.45E-03	2,4-dinitrophenol	2.42E-08	NA
2,4-dinitrotoluene	4.90E-06	2.00E-03	2.45E-03	2,4-dinitrotoluene	2.42E-08	3.10E-01
2,4,5-trichlorophenol	4.90E-06	1.00E+00	4.90E-06	2,4,5-trichlorophenol	2.42E-08	NA
2,4,6-trichlorophenol	4.90E-06	NA	NA	2,4,6-trichlorophenol	2.42E-08	7.00E-02
2,6-dinitrotoluene	4.90E-06	1.00E-02	4.90E-04	2,6-dinitrotoluene	2.42E-08	6.80E-01
3,3-dichlorobenzidine	4.90E-06	NA	NA	3,3-dichlorobenzidine	2.42E-08	1.20E+00
4-chloroaniline	4.90E-06	4.00E-03	1.22E-03	4-chloroaniline	2.42E-08	NA
4-methyl-2-pentanone	4.90E-06	8.00E-01	6.12E-06	4-methyl-2-pentanone	2.42E-08	NA

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Intake Equation	=	CS X EEx ED X CFX IR BW X AT
IRs	Ingestion rate of soil (RAGS, 1989)	480 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	90 d/year
EDn	Exposure duration for non-carcinogens	1 year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 day
ATn	Average time for non-carcinogens (EDn x 365)	126 day
CS	Concentration of chemicals in soil (see table below)	
Chemical Concentrations		
Compound	Concentration	Concentration
4-methylphenol	1.0E+00	1.0E+00
4,4-did	1.0E+00	1.0E+00
4,4-dde	1.0E+00	1.0E+00
4,4-ddt	1.0E+00	1.0E+00
acenaphthene	1.0E+00	1.0E+00
acetone	1.0E+00	1.0E+00
acrolein	1.0E+00	1.0E+00
acrylonitrile	1.0E+00	1.0E+00
aldrin	1.0E+00	1.0E+00
alpha-bhc	1.0E+00	1.0E+00
aniline	1.0E+00	1.0E+00
anthracene	1.0E+00	1.0E+00
antimony	1.0E+00	1.0E+00
aroclor 1016	1.0E+00	1.0E+00
aroclor 1254	1.0E+00	1.0E+00
arsenic		

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ^a	UR (unitless)
4-methylphenol	4.90E-06	5.00E-03	9.80E-04	4-methylphenol	2.42E-08	NA
4,4-ddd	4.90E-06	NA	NA	4,4-ddd	2.42E-08	5.80E-09
4,4-dde	4.90E-06	NA	NA	4,4-dde	2.42E-08	8.21E-09
4,4-ddt	4.90E-06	5.00E-04	9.80E-03	4,4-ddt	2.42E-08	8.21E-09
acenaphthene	4.90E-06	6.00E-01	8.16E-06	acenaphthene	2.42E-08	NA
acetone	4.90E-06	1.00E+00	4.90E-06	acetone	2.42E-08	NA
acrolein	4.90E-06	NA	NA	acrolein	2.42E-08	NA
acrylonitrile	4.90E-06	1.00E-02	4.90E-04	acrylonitrile	2.42E-08	1.00E+00
aldrin	4.90E-06	3.00E-05	1.63E-01	aldrin	2.42E-08	1.70E+01
alpha-bhc	4.90E-06	NA	NA	alpha-bhc	2.42E-08	6.30E+00
aniline	4.90E-06	NA	NA	aniline	2.42E-08	1.52E-07
anthracene	4.90E-06	3.00E-01	1.63E-05	anthracene	2.42E-08	NA
antimony	4.90E-06	4.00E-04	1.22E-02	antimony	2.42E-08	NA
aroclor 1016	4.90E-06	NA	NA	aroclor 1016	2.42E-08	NA
aroclor 1254	4.90E-06	5.00E-05	9.80E-02	aroclor 1254	2.42E-08	NA
arsenic	4.90E-06	3.00E-04	1.63E-02	arsenic	2.42E-08	1.50E+00
barium	4.90E-06	7.00E-02	7.00E-05	barium	2.42E-08	NA
benzene	4.90E-06	NA	NA	benzene	2.42E-08	1.00E-01
benzidine	4.90E-06	3.00E-03	1.63E-03	benzidine	2.42E-08	5.00E+02
benzoic acid	4.90E-06	4.00E+00	1.22E-06	benzoic acid	2.42E-08	1.21E-05
benzo(a)anthracene	4.90E-06	NA	NA	benzo(a)anthracene	2.42E-08	NA
benzo(a)pyrene	4.90E-06	NA	NA	benzo(a)pyrene	2.42E-08	NA
benzo(b)fluoranthene	4.90E-06	NA	NA	benzo(b)fluoranthene	2.42E-08	NA
benzo(k)fluoranthene	4.90E-06	NA	NA	benzo(k)fluoranthene	2.42E-08	1.20E+00
benzyl alcohol	4.90E-06	1.00E+00	4.90E-06	benzyl alcohol	2.42E-08	NA
benzyl chloride	4.90E-06	NA	NA	benzyl chloride	2.42E-08	4.11E-07
beryllium	4.90E-06	5.00E-03	9.80E-04	beryllium	2.42E-08	NA
beta-bhc	4.90E-06	NA	NA	beta-bhc	2.42E-08	1.80E+00
beta-chloronaphthalene	4.90E-06	NA	NA	beta-chloronaphthalene	2.42E-08	NA
bis(2-chloro-1-methylethyl)ether	4.90E-06	NA	NA	bis(2-chloro-1-methylethyl)ether	2.42E-08	1.69E-09

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Intake Equation = CS X EF X ED X CF X IR
 BW X AT

Compound	Concentration	Compound	Concentration
bis(2-chloroethyl)ether	1.0E+00	cis-1,2-dichloroethene	1.0E+00
bis(2-ethylhexyl)phthalate	1.0E+00	copper	1.0E+00
bromodichloromethane	1.0E+00	cumene	1.0E+00
bromoform	1.0E+00	cyanide	1.0E+00
bromomethane	1.0E+00	dibenz(a,h)anthracene	1.0E+00
cadmium	1.0E+00	dibromochloromethane	1.0E+00
carbazole	1.0E+00	dichlorodifluoromethane	1.0E+00
carbon disulfide	1.0E+00	dieldrin	1.0E+00
carbon tetrachloride	1.0E+00	diethyl phthalate	1.0E+00
chlordane	1.0E+00	di-n-butylphthalate	1.0E+00
chlorobenzene	1.0E+00	di-n-octylphthalate	1.0E+00
chloroform	1.0E+00	endosulfan	1.0E+00
chloromethane	1.0E+00	endrin	1.0E+00
chromium iii	1.0E+00	ethyl chloride	
chromium vi	1.0E+00		
chrysene	1.0E+00		

Chemical Concentrations

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
bis(2-chloroethyl)ether	4.90E-06	NA	NA	2.42E-08	2.50E+00	6.04E-08
bis(2-ethylhexyl)phthalate	4.90E-06	NA	NA	2.42E-08	8.40E-03	2.03E-10
bromodichloromethane	4.90E-06	2.00E-02	2.45E-04	2.42E-08	1.30E-01	3.14E-09
bromoform	4.90E-06	2.00E-02	2.45E-04	2.42E-08	7.93E-03	1.92E-10
bromomethane	4.90E-06	NA	NA	NA	NA	NA
cadmium	4.90E-06	5.00E-04	9.80E-03	2.42E-08	NA	NA
carbazole	4.90E-06	NA	NA	2.42E-08	2.00E-02	4.83E-10
carbon disulfide	4.90E-06	1.00E-01	4.90E-05	2.42E-08	NA	NA
carbon tetrachloride	4.90E-06	NA	NA	2.42E-08	1.50E-01	3.62E-09
chlorodane	4.90E-06	6.00E-05	8.16E-02	2.42E-08	1.20E+00	2.90E-08
chlorobenzene	4.90E-06	NA	NA	2.42E-08	NA	NA
chloroform	4.90E-06	1.00E-02	4.90E-04	2.42E-08	3.10E-02	7.49E-10
chloromethane	4.90E-06	NA	NA	2.42E-08	1.30E-02	3.14E-10
chromium iii	4.90E-06	1.00E+00	4.90E-06	2.42E-08	NA	NA
chromium vi	4.90E-06	2.00E-02	2.45E-04	2.42E-08	NA	NA
chrysene	4.90E-06	NA	NA	2.42E-08	1.20E-01	2.90E-09
cis-1,2-dichloroethene	4.90E-06	1.00E-01	4.90E-05	2.42E-08	NA	NA
copper	4.90E-06	3.70E-02	1.32E-04	2.42E-08	NA	NA
cumene	4.90E-06	4.00E-01	1.22E-05	2.42E-08	NA	NA
cyanide	4.90E-06	2.00E-02	2.45E-04	2.42E-08	NA	NA
dibenzo(a,h)anthracene	4.90E-06	NA	NA	2.42E-08	4.10E+00	9.90E-08
dibromochloromethane	4.90E-06	2.00E-01	2.45E-05	2.42E-08	9.40E-02	2.27E-09
dichlorodifluoromethane	4.90E-06	9.00E-01	5.44E-06	2.42E-08	NA	NA
dieldrin	4.90E-06	5.00E-05	9.80E-02	2.42E-08	1.60E+01	3.86E-07
diethyl phthalate	4.90E-06	8.00E+00	6.12E-07	2.42E-08	NA	NA
di-n-butylphthalate	4.90E-06	1.00E+00	4.90E-06	2.42E-08	NA	NA
di-n-octylphthalate	4.90E-06	2.00E-02	2.45E-04	2.42E-08	NA	NA
endosulfan	4.90E-06	6.00E-03	8.16E-04	2.42E-08	NA	NA
endrin	4.90E-06	3.00E-04	1.63E-02	2.42E-08	NA	NA
ethyl chloride	4.90E-06	NA	NA	2.42E-08	NA	NA

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Intake Equation

$$CS \times EF \times ED \times CF \times IR \\ BW \times AT$$

IRs	Ingestion rate of soil (RAGS, 1989)	480 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	90 d/year
EDn	Exposure duration for non-carcinogens	1 year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 day
ATn	Average time for non-carcinogens (EDn x 365)	126 day
CS	Concentration of chemicals in soil (see table below)	

Chemical Concentrations

Compound	Concentration	Concentration
ethylbenzene	1.0E+00	methylene bromide
fluoranthene	1.0E+00	methylene chloride
fluorene	1.0E+00	methyl-tert-butyl ether
gamma-hbc	1.0E+00	molybdenum
heptachlor	1.0E+00	n-butylbenzyl phthalate
heptachlor epoxide	1.0E+00	nickel
hexachlorobenzene	1.0E+00	nitroaniline, o-
hexachlorobutadiene	1.0E+00	nitrobenzene
hexachlorocyclopentadiene	1.0E+00	nitrosodiphenylamine, p-
hexachloroethane	1.0E+00	n-nitrosodimethylamine
indeno[1,2,3-cd]pyrene	1.0E+00	n-nitroso-di-t-butylamine
isobutyl alcohol	1.0E+00	n-nitrosodiphenylamine
isophorone	1.0E+00	o-chlorotoluene
mercury	1.0E+00	p-chloro-m-cresol
methoxychlor	1.0E+00	
methyl methacrylate	1.0E+00	

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ₁	UR (unitless)
ethylbenzene	4.90E-06	NA	NA	2.42E-08	NA	NA
fluoranthene	4.90E-06	4.00E-01	1.22E-05	2.42E-08	NA	NA
fluorene	4.90E-06	4.00E-01	1.22E-05	2.42E-08	NA	NA
gamma-bhc	4.90E-06	3.00E-03	1.63E-03	2.42E-08	1.10E+00	2.66E-08
heptachlor	4.90E-06	5.00E-04	9.80E-03	2.42E-08	5.70E+00	1.38E-07
heptachlor epoxide	4.90E-06	1.30E-05	3.77E-01	2.42E-08	1.30E+01	3.14E-07
hexachlorobenzene	4.90E-06	NA	NA	2.42E-08	1.80E+00	4.35E-08
hexachlorobutadiene	4.90E-06	NA	NA	2.42E-08	7.80E-02	1.88E-09
hexachlorocyclopentadiene	4.90E-06	7.00E-02	7.00E-05	2.42E-08	NA	NA
hexachloroethane	4.90E-06	1.00E-02	4.90E-04	2.42E-08	3.90E-02	9.42E-10
indenof(1,2,3-cd)pyrene	4.90E-06	NA	NA	2.42E-08	1.20E+00	2.90E-08
isobutyl alcohol	4.90E-06	3.00E+00	1.63E-06	2.42E-08	NA	NA
isophorone	4.90E-06	2.00E+00	2.45E-06	2.42E-08	9.50E-04	2.29E-11
mercury	4.90E-06	3.00E-04	1.63E-02	2.42E-08	NA	NA
methoxychlor	4.90E-06	5.00E-03	9.80E-04	2.42E-08	NA	NA
methyl methacrylate	4.90E-06	8.00E-02	6.12E-05	2.42E-08	NA	NA
methylene bromide	4.90E-06	1.00E-01	4.90E-05	2.42E-08	NA	NA
methylene chloride	4.90E-06	6.00E-02	8.16E-05	2.42E-08	1.40E-02	3.38E-10
methyl-tert-butyl ether	4.90E-06	NA	NA	2.42E-08	NA	NA
molybdenum	4.90E-06	4.00E-02	1.22E-04	2.42E-08	NA	NA
n-butylbenzyl phthalate	4.90E-06	2.00E-01	2.45E-05	2.42E-08	NA	NA
nickel	4.90E-06	2.00E-02	2.45E-04	2.42E-08	NA	NA
nitroaniline, o-	4.90E-06	NA	NA	2.42E-08	NA	NA
nitrobenzene	4.90E-06	5.00E-03	9.80E-04	2.42E-08	NA	NA
nitrosodiphenylamine, p-				2.42E-08	2.20E-02	5.31E-10
n-nitrosodimethylamine	4.90E-06	NA	NA	2.42E-08	1.60E+01	3.86E-07
n-nitroso-di-n-propylamine	4.90E-06	NA	NA	2.42E-08	7.00E+00	1.69E-07
n-nitrosodiphenylamine	4.90E-06	NA	NA	2.42E-08	9.00E-03	2.17E-10
o-chlorotoluene	4.90E-06	2.00E-01	2.45E-05	2.42E-08	NA	NA
p-chloro-m-cresol	4.90E-06	2.00E+00	2.45E-06	2.42E-08	NA	NA

Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ₁	UR (unitless)
ethylbenzene	4.90E-06	NA	NA
fluoranthene	4.90E-06	NA	NA
fluorene	4.90E-06	NA	NA
gamma-bhc	4.90E-06	NA	NA
heptachlor	4.90E-06	NA	NA
heptachlor epoxide	4.90E-06	NA	NA
hexachlorobenzene	4.90E-06	NA	NA
hexachlorobutadiene	4.90E-06	NA	NA
hexachlorocyclopentadiene	4.90E-06	NA	NA
hexachloroethane	4.90E-06	NA	NA
indeno(1,2,3-cd)pyrene	4.90E-06	NA	NA
isobutyl alcohol	4.90E-06	NA	NA
isophorone	4.90E-06	NA	NA
mercury	4.90E-06	NA	NA
methoxychlor	4.90E-06	NA	NA
methyl methacrylate	4.90E-06	NA	NA
methylene bromide	4.90E-06	NA	NA
methylene chloride	4.90E-06	NA	NA
methyl-tert-butyl ether	4.90E-06	NA	NA
molybdenum	4.90E-06	NA	NA
n-butylbenzyl phthalate	4.90E-06	NA	NA
nickel	4.90E-06	NA	NA
nitroaniline, o-	4.90E-06	NA	NA
nitrobenzene	4.90E-06	NA	NA
nitrosodiphenylamine, p-		2.42E-08	5.31E-10
n-nitrosodimethylamine	4.90E-06	NA	NA
n-nitroso-di-n-propylamine	4.90E-06	NA	NA
n-nitrosodiphenylamine	4.90E-06	NA	NA
o-chlorotoluene	4.90E-06	NA	NA
p-chloro-m-cresol	4.90E-06	NA	NA

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Intake Equation	CS X EF X ED X CF X IR BW X AT	Concentration	Compound	Concentration
IRs	Ingestion rate of soil (RAGS, 1989)	480 mg/day		
CF	Conversion factor	1.0E+06 kg/mg		
EF	Exposure frequency	90 d/year		
EDn	Exposure duration for non-carcinogens	1 year		
EDc	Exposure duration for carcinogens	1 year		
BW	Body weight	70 kg		
ATc	Average time for carcinogens (lifetime)	25550 day		
ATn	Average time for non-carcinogens (EDn x 365)	126 day		
CS	Concentration of chemicals in soil (see table below)			
Chemical Concentrations				
Compound	Concentration	Compound	Concentration	
pentachlorophenol	1.0E+00	zinc	1.0E+00	
phenol	1.0E+00			
pyrene	1.0E+00			
selenium	1.0E+00			
silver	1.0E+00			
styrene	1.0E+00			
tetrachloroethene	1.0E+00			
toluene	1.0E+00			
toxaphene	1.0E+00			
trans-1,2-dichloroethylene	1.0E+00			
trichloroethene	1.0E+00			
trichlorofluoromethane	1.0E+00			
vanadium	1.0E+00			
vinyl acetate	1.0E+00			
vinyl chloride	1.0E+00			
xylenes	1.0E+00			

Table A-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Incidental Ingestion of Soils

Compound	Carcinogenic Calculation		
	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
pentachlorophenol	2.42E-08	1.80E-02	4.35E-10
phenol	2.42E-08	NA	NA
pyrene	2.42E-08	NA	NA
selenium	2.42E-08	NA	NA
silver	2.42E-08	NA	NA
styrene	2.42E-08	NA	NA
tetrachloroethene	2.42E-08	5.10E-02	1.23E-09
toluene	2.42E-08	NA	NA
toxaphene	2.42E-08	1.20E+00	2.90E-08
trans-1,2-dichloroethene	2.42E-08	NA	NA
trichloroethylene	2.42E-08	1.50E-02	3.62E-10
trichlorofluoromethane	2.42E-08	NA	NA
vanadium	2.42E-08	NA	NA
vinyl acetate	2.42E-08	NA	NA
vinylic chloride	2.42E-08	2.70E-01	6.52E-09
xylenes	2.42E-08	NA	NA
zinc	2.42E-08	NA	NA

Appendix B

Table B-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

$$\text{Intake Equation} = \text{CS} \times \text{CF} \times \text{EF} \times \text{ED} \times \text{AF} \times \text{ABS} \times \text{SA}$$

SA	Surface area of exposed skin (50th percentile, hands only)	5800	cm ² /day
AF	Adherence factor	1	mg/cm ²
ABS	Absorption factor (see table below)	csv	
CF	Conversion factor	1.0E-06	kg/mg
EF	Exposure frequency	90	d/year
EDn	Exposure duration for non-carcinogens	1	year
EDc	Exposure duration for carcinogens	1	year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	day
ATn	Average time for non-carcinogens (EDn × 365)	126	day
CS	Concentration of chemicals in soil (see table below)	csv	

Chemical Concentrations

Compound	ABS (unitless)	Concentration (mg/kg)	Compound	ABS (unitless)	Concentration (mg/kg)
1-butanol	NA	1.00E+00	2-butanone	1.00E-01	1.00E+00
1,1-dichloroethane	1.00E-01	1.00E+00	2-chlorophenol	1.00E-01	1.00E+00
1,1-dichloroethene	1.00E-01	1.00E+00	2-methylphenol	1.00E-01	1.00E+00
1,1,1,2-tetrachloroethane	1.00E-01	1.00E+00	2-naphthylamine	1.00E-01	1.00E+00
1,1,2-trichloroethane	1.00E-01	1.00E+00	2,4-dichlorophenol	1.00E-01	1.00E+00
1,1,2,2-tetrachloroethane	1.00E-01	1.00E+00	2,4-dimethylphenol	1.00E-01	1.00E+00
1,2-dibromo-3-chloropropane	1.00E-01	1.00E+00	2,4-dinitrophenol	1.00E-01	1.00E+00
1,2-dibromoethane	1.00E-01	1.00E+00	2,4-dinitrotoluene	1.00E-01	1.00E+00
1,2-dichlorobenzene	1.00E-01	1.00E+00	2,4,5-trichlorophenol	1.00E-01	1.00E+00
1,2-dichloroethane	1.00E-01	1.00E+00	2,4,6-trichlorophenol	1.00E-01	1.00E+00
1,2-dichloropropane	1.00E-01	1.00E+00	2,6-dinitrotoluene	1.00E-01	1.00E+00
1,2-diphenylhydrazine	1.00E-01	1.00E+00	3,3-dichlorobenzidine	1.00E-01	1.00E+00
1,2,3-trichloropropane	1.00E-01	1.00E+00	4-chloroaniline	1.00E-01	1.00E+00
1,2,4-trichlorobenzene	1.00E-01	1.00E+00	4-methyl-2-pentanone	1.00E-01	1.00E+00
1,3-dichloropropene	1.00E-01	1.00E+00			
1,4-dichlorobenzene	1.00E-01	1.00E+00			

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d), NA	UR (unitless) NA
1-butanol	NA	9.00E-01	NA	2.92E-08	6.33E-03	1.85E-10
1,1-dichloroethane	5.92E-06	9.00E-01	6.58E-06	1.1-dichloroethane	2.92E-08	6.67E-01
1,1,1,2-tetrachloroethane	5.92E-06	8.10E-03	7.31E-04	1,1,1,2-tetrachloroethane	2.92E-08	2.89E-02
1,1,2-trichloroethane	5.92E-06	2.70E-02	2.19E-04	1,1,2-trichloroethane	2.92E-08	8.00E-02
1,1,2,2-tetrachloroethane	5.92E-06	3.60E-02	1.64E-04	1,1,2,2-tetrachloroethane	2.92E-08	3.00E-01
1,2-dibromo-3-chloropropane	5.92E-06	NA	NA	1,2-dibromo-3-chloropropane	2.92E-08	8.76E-09
1,2-dibromoethane	5.92E-06	NA	NA	1,2-dibromoethane	2.92E-08	7.78E+00
1,2-dichlorobenzene	5.92E-06	NA	NA	1,2-dichlorobenzene	2.92E-08	NA
1,2-dichloroethane	5.92E-06	NA	NA	1,2-dichloroethane	2.92E-08	7.78E-02
1,2-dichloropropane	5.92E-06	NA	NA	1,2-dichloropropane	2.92E-08	7.00E-02
1,2-diphenylhydrazine	5.92E-06	NA	NA	1,2-diphenylhydrazine	2.92E-08	9.67E-01
1,2,3-trichloropropane	5.92E-06	5.40E-02	1.10E-04	1,2,3-trichloropropane	2.92E-08	7.78E+00
1,2,4-trichlorobenzene	5.92E-06	9.00E-03	6.58E-04	1,2,4-trichlorobenzene	2.92E-08	NA
1,3-dichloropropene	5.92E-06	2.70E-03	2.19E-03	1,3-dichloropropene	2.92E-08	2.00E-01
1,4-dichlorobenzene	5.92E-06	NA	NA	1,4-dichlorobenzene	2.92E-08	4.44E-02
2-butanone	5.92E-06	1.80E+00	3.29E-06	2-butanone	2.92E-08	NA
2-chlorophenol	5.92E-06	4.50E-02	1.32E-04	2-chlorophenol	2.92E-08	NA
2-methylphenol	5.92E-06	4.50E-01	1.32E-05	2-methylphenol	2.92E-08	NA
2-naphthylamine	5.92E-06	NA	NA	2-naphthylamine	2.92E-08	2.00E+00
2,4-dichlorophenol	5.92E-06	2.70E-03	2.19E-03	2,4-dichlorophenol	2.92E-08	NA
2,4-dimethylphenol	5.92E-06	1.80E-01	3.29E-05	2,4-dimethylphenol	2.92E-08	NA
2,4-dinitrophenol	5.92E-06	1.80E-03	3.29E-03	2,4-dinitrophenol	2.92E-08	NA
2,4-dinitrotoluene	5.92E-06	1.80E-03	3.29E-03	2,4-dinitrotoluene	2.92E-08	3.44E-01
2,4,5-trichlorophenol	5.92E-06	9.00E-01	6.58E-06	2,4,5-trichlorophenol	2.92E-08	NA
2,4,6-trichlorophenol	5.92E-06	NA	NA	2,4,6-trichlorophenol	2.92E-08	7.78E-02
2,6-dinitrotoluene	5.92E-06	9.00E-03	6.58E-04	2,6-dinitrotoluene	2.92E-08	7.56E-01
3,3-dichlorobenzidine	5.92E-06	NA	NA	3,3-dichlorobenzidine	2.92E-08	1.33E+00
4-chloroaniline	5.92E-06	3.60E-03	1.64E-03	4-chloroaniline	2.92E-08	NA
4-methyl-2-pentanone	5.92E-06	7.20E-01	8.22E-06	4-methyl-2-pentanone	2.92E-08	NA

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

$$\text{Intake Equation} = \text{CS} \times \text{CF} \times \text{EF} \times \text{ED} \times \text{AF} \times \text{BW} \times \text{AT}$$

SA	Surface area of exposed skin (50th percentile, hands only)	5800 cm ² /day
AF	Adherence Factor (see table below)	1 mg/cm ²
ABS	Absorption factor	csv
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	90 d/year
EDn	Exposure duration for non-carcinogens	1 year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 day
ATn	Average time for non-carcinogens (EDn x 165)	126 day
CS	Concentration of chemicals in soil (see table below)	csv

Chemical Concentrations

Compound	Concentration (mg/kg)	Compound	Concentration (mg/kg)
4-methylphenol	1.00E+01	barium	1.00E-02
4,4-ddd	5.00E-02	benzene	1.00E-01
4,4-dde	5.00E-02	benzidine	1.00E-01
4,4-ddt	5.00E-02	benzoic acid	1.00E-01
acenaphthene	1.50E-01	benzo(a)anthracene	1.50E-01
acetone	1.00E-01	benzo(a)pyrene	1.50E-01
acrolein	1.00E-01	benzo(b)fluoranthene	1.50E-01
acrylonitrile	1.00E-01	benzo(k)fluoranthene	1.50E-01
aldrin	5.00E-02	benzyl alcohol	1.00E-01
alpha-bhc	5.00E-02	benzyl chloride	1.00E-01
aniline	1.00E-01	beryllium	1.00E-02
anthracene	1.50E-01	beta-bhc	5.00E-02
antimony	1.00E-02	beta-chloronaphthalene	1.00E-01
aroclor 1016	1.00E-01	bis(2-chloro-1-methylethyl)ether	1.00E-01
aroclor 1254	1.00E-01		
arsenic	3.00E-02		

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ¹
4-methylphenol	5.92E-06	4.50E-03	1.32E-03	4-methylphenol	2.92E-08	NA
4,4-ddd	2.96E-06	NA	NA	4,4-ddd	1.46E-08	2.67E-01
4,4-dde	2.96E-06	NA	NA	4,4-dde	1.46E-08	3.78E-01
4,4-ddt	2.96E-06	NA	NA	4,4-ddt	1.46E-08	3.78E-01
acenaphthene	8.88E-06	5.40E-01	6.58E-03	acenaphthene	4.38E-08	NA
acetone	5.92E-06	9.00E-01	6.58E-06	acetone	2.92E-08	NA
acrolein	5.92E-06	NA	NA	acrolein	2.92E-08	NA
acrylonitrile	5.92E-06	9.00E-03	6.58E-04	acrylonitrile	2.92E-08	1.11E+00
aldrin	2.96E-06	2.70E-05	1.10E-01	aldrin	1.46E-08	1.89E+01
alpha-bhc	2.96E-06	NA	NA	alpha-bhc	1.46E-08	7.00E+00
aniline	5.92E-06	NA	NA	aniline	2.92E-08	6.33E-03
anthracene	8.88E-06	2.70E-01	3.29E-05	anthracene	4.38E-08	NA
antimony	5.92E-07	6.00E-05	9.86E-03	antimony	2.92E-09	NA
aroclor 1016	5.92E-06	NA	NA	aroclor 1016	2.92E-08	NA
aroclor 1254	5.92E-06	4.50E-05	1.32E-01	aroclor 1254	2.92E-08	NA
arsenic	1.79E-06	2.86E-04	6.23E-03	arsenic	8.76E-09	1.58E+00
barium	5.92E-07	6.37E-02	9.29E-06	barium	2.92E-09	NA
benzene	5.92E-06	NA	NA	benzene	2.92E-08	1.11E-01
benzidine	5.92E-06	2.70E-03	2.19E-03	benzidine	2.92E-08	5.56E+02
benzoic acid	5.92E-06	3.60E+00	1.64E-06	benzoic acid	2.92E-08	NA
benzo(a)anthracene	8.88E-06	NA	NA	benzo(a)anthracene	4.38E-08	1.33E+00
benzo(a)pyrene	8.88E-06	NA	NA	benzo(a)pyrene	4.38E-08	1.33E+01
benzo(b)fluoranthene	8.88E-06	NA	NA	benzo(b)fluoranthene	4.38E-08	1.33E+00
benzo(k)fluoranthene	8.88E-06	NA	NA	benzo(k)fluoranthene	4.38E-08	1.33E+00
benzyl alcohol	5.92E-06	9.00E-01	6.58E-06	benzyl alcohol	2.92E-08	NA
benzyl chloride	5.92E-06	NA	NA	benzyl chloride	2.92E-08	1.89E-01
beryllium	5.92E-07	5.00E-05	1.18E-02	beryllium	2.92E-09	NA
beta-bhc	2.96E-06	NA	NA	beta-bhc	1.46E-08	2.00E+00
beta-chloronaphthalene	5.92E-06	NA	NA	beta-chloronaphthalene	2.92E-08	NA
bis(2-chloro-1-methylethyl)ether	5.92E-06	NA	NA	bis(2-chloro-1-methylethyl)ether	2.92E-08	7.78E-02

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ¹
4-methylphenol	5.92E-06	4.50E-03	1.32E-03	4-methylphenol	2.92E-08	NA
4,4-ddd	2.96E-06	NA	NA	4,4-ddd	1.46E-08	2.67E-01
4,4-dde	2.96E-06	NA	NA	4,4-dde	1.46E-08	3.78E-01
4,4-ddt	2.96E-06	NA	NA	4,4-ddt	1.46E-08	3.78E-01
acenaphthene	8.88E-06	5.40E-01	6.64E-05	acenaphthene	4.38E-08	NA
acetone	5.92E-06	9.00E-01	6.58E-06	acetone	2.92E-08	NA
acrolein	5.92E-06	NA	NA	acrolein	2.92E-08	NA
acrylonitrile	5.92E-06	9.00E-03	6.58E-04	acrylonitrile	2.92E-08	1.11E+00
aldrin	2.96E-06	2.70E-05	1.10E-01	aldrin	1.46E-08	1.89E+01
alpha-bhc	2.96E-06	NA	NA	alpha-bhc	1.46E-08	7.00E+00
aniline	5.92E-06	NA	NA	aniline	2.92E-08	1.85E-10
anthracene	8.88E-06	2.70E-01	3.29E-05	anthracene	4.38E-08	NA
antimony	5.92E-07	6.00E-05	9.86E-03	antimony	2.92E-09	NA
aroclor 1016	5.92E-06	NA	NA	aroclor 1016	2.92E-08	NA
aroclor 1254	5.92E-06	4.50E-05	1.32E-01	aroclor 1254	2.92E-08	NA
arsenic	1.79E-06	2.86E-04	6.23E-03	arsenic	8.76E-09	1.38E-08
barium	5.92E-07	6.37E-02	9.29E-06	barium	2.92E-09	NA
benzene	5.92E-06	NA	NA	benzene	2.92E-08	3.24E-09
benzidine	5.92E-06	2.70E-03	2.19E-03	benzidine	2.92E-08	1.62E-05
benzoic acid	5.92E-06	3.60E+00	1.64E-06	benzoic acid	2.92E-08	NA
benzo(a)anthracene	8.88E-06	NA	NA	benzo(a)anthracene	4.38E-08	5.84E-08
benzo(a)pyrene	8.88E-06	NA	NA	benzo(a)pyrene	4.38E-08	5.84E-07
benzo(b)fluoranthene	8.88E-06	NA	NA	benzo(b)fluoranthene	4.38E-08	5.84E-08
benzo(k)fluoranthene	8.88E-06	NA	NA	benzo(k)fluoranthene	4.38E-08	5.84E-08
benzyl alcohol	5.92E-06	9.00E-01	6.58E-06	benzyl alcohol	2.92E-08	NA
benzyl chloride	5.92E-06	NA	NA	benzyl chloride	2.92E-08	1.89E-01
beryllium	5.92E-07	5.00E-05	1.18E-02	beryllium	2.92E-09	NA
beta-bhc	2.96E-06	NA	NA	beta-bhc	1.46E-08	2.92E-08
beta-chloronaphthalene	5.92E-06	NA	NA	beta-chloronaphthalene	2.92E-08	NA
bis(2-chloro-1-methylethyl)ether	5.92E-06	NA	NA	bis(2-chloro-1-methylethyl)ether	2.92E-08	2.27E-09

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Intake Equation = CS X CF X EF X ED X AF X ABS X SA
 BW X AT

SA	Surface area of exposed skin (50th percentile, hands only)	5800 cm/day
AF	Adherence Factor	1 mg/cm ²
ABS	Absorption factor (see table below)	csv
CF	Conversion factor	1.0E-06
EF	Exposure frequency	kg/mg
EDn	Exposure duration for non-carcinogens	90 d/year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 day
ATn	Average time for non-carcinogens (EDn x 365)	126 day
CS	Concentration of chemicals in soil (see table below)	csv

Chemical Concentrations

Compound	ABS (unitless)	Concentration (mg/kg)	Compound	ABS (unitless)	Concentration (mg/kg)
bis(2-chloroethyl)ether	1.00E-01	1.00E+00	cis-1,2-dichloroethene	1.00E-01	1.00E+00
bis(2-ethylhexyl)phthalate	1.00E-01	1.00E+00	copper	1.00E-02	1.00E+00
bromodichloromethane	1.00E-01	1.00E+00	cumene	1.00E-01	1.00E+00
bronform	1.00E-01	1.00E+00	cyanide	1.00E-02	1.00E+00
bromomethane	1.00E-01	1.00E+00	dibenz(a,h)anthracene	1.50E-01	1.00E+00
cadmium	1.00E-03	1.00E+00	chloromochloromethane	1.00E-01	1.00E+00
carbazole	1.00E-01	1.00E+00	dichlorodifluoromethane	1.00E-01	1.00E+00
carbon disulfide	1.00E-01	1.00E+00	cieldrin	5.00E-02	1.00E+00
carbon tetrachloride	1.00E-01	1.00E+00	diethyl phthalate	1.00E-01	1.00E+00
chlor dane	1.00E-01	1.00E+00	di-n-butylphthalate	1.00E-01	1.00E+00
chlorobenzene	1.00E-01	1.00E+00	di-n-octylphthalate	1.00E-01	1.00E+00
chloroform	1.00E-01	1.00E+00	endosulfan	5.00E-02	1.00E+00
chloromethane	1.00E-01	1.00E+00	endrin	5.00E-02	1.00E+00
chromium iii	1.00E-02	1.00E+00	ethyl chloride	1.00E-01	1.00E+00
chromium vi	1.00E-04	1.00E+00			
chrysene	1.50E-01	1.00E+00			

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
bis(2-chloroethyl)ether	5.92E-06	NA	NA	2.92E-08	2.78E-09	8.11E-08
bis(2-ethylhexyl)phthalate	5.92E-06	NA	NA	2.92E-08	9.33E-03	2.72E-10
bromodichloromethane	5.92E-06	1.80E-02	3.29E-04	2.92E-08	1.44E-01	4.22E-09
bromoform	5.92E-06	1.80E-02	3.29E-04	2.92E-08	8.81E-03	2.57E-10
bromomethane	5.92E-06	NA	NA	2.92E-08	NA	NA
cadmium	5.92E-08	2.50E-05	2.37E-03	2.92E-10	NA	NA
carbazole	5.92E-06	NA	NA	2.92E-08	2.22E-02	6.49E-10
carbon disulfide	5.92E-06	9.00E-02	6.58E-05	2.92E-08	NA	NA
carbon tetrachloride	5.92E-06	NA	NA	2.92E-08	1.67E-01	4.86E-09
chlor dane	5.92E-06	5.40E-05	1.10E-01	2.92E-08	1.33E+00	3.89E-08
chlorobenzene	5.92E-06	NA	NA	2.92E-08	NA	NA
chloroform	5.92E-06	1.00E-02	5.92E-04	2.92E-08	3.10E-02	9.05E-10
chloromethane	5.92E-06	NA	NA	2.92E-08	1.44E-02	4.22E-10
chromium iii	5.92E-07	4.50E-01	1.32E-06	2.92E-09	NA	NA
chromium vi	5.92E-09	9.00E-03	6.58E-07	2.92E-11	9.33E-01	2.72E-11
chrysene	8.88E-06	NA	NA	4.38E-08	1.33E-01	5.84E-09
cis-1,2-dichloroethene	5.92E-06	9.00E-02	6.58E-05	2.92E-08	NA	NA
copper	5.92E-07	2.22E-02	2.67E-05	2.92E-09	NA	NA
cumene	5.92E-06	3.60E-01	1.64E-05	2.92E-08	NA	NA
cyanide	5.92E-07	1.44E-02	4.11E-05	2.92E-09	NA	NA
dibenz(a,h)anthracene	8.88E-06	NA	NA	4.38E-08	4.56E+00	1.99E-07
dibromochloromethane	5.92E-06	1.80E-01	3.29E-05	2.92E-08	1.04E-01	3.05E-09
dichlorodifluoromethane	5.92E-06	8.10E-01	7.31E-06	2.92E-08	NA	NA
dieldrin	2.96E-06	4.50E-05	6.58E-02	1.46E-08	1.78E-01	2.59E-07
diethyl phthalate	5.92E-06	7.20E-01	8.22E-07	2.92E-08	NA	NA
di-n-butylphthalate	5.92E-06	9.00E-01	6.58E-06	2.92E-08	NA	NA
di-n-octylphthalate	5.92E-06	1.80E-02	3.29E-04	2.92E-08	NA	NA
endosulfan	2.96E-06	5.40E-03	5.48E-04	1.46E-08	NA	NA
endrin	2.96E-06	2.70E-04	1.10E-02	1.46E-08	NA	NA
ethyl chloride	5.92E-06	NA	NA	2.92E-08	NA	NA

Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
bis(2-chloroethyl)ether	5.92E-06	2.78E-09	8.11E-08
bis(2-ethylhexyl)phthalate	5.92E-06	9.33E-03	2.72E-10
bromodichloromethane	5.92E-06	2.92E-08	4.22E-09
bromoform	5.92E-06	2.92E-08	2.57E-10
bromomethane	5.92E-06	NA	NA
cadmium	5.92E-08	2.92E-10	NA
carbazole	5.92E-06	2.92E-08	6.49E-10
carbon disulfide	5.92E-06	2.92E-08	NA
carbon tetrachloride	5.92E-06	2.92E-08	1.67E-01
chlor dane	5.92E-06	2.92E-08	1.33E+00
chlorobenzene	5.92E-06	2.92E-08	NA
chloroform	5.92E-06	2.92E-08	3.10E-02
chloromethane	5.92E-06	2.92E-08	4.22E-10
chromium iii	5.92E-07	2.92E-09	NA
chromium vi	5.92E-09	2.92E-11	9.33E-01
chrysene	8.88E-06	4.38E-08	1.33E-01
cis-1,2-dichloroethene	5.92E-06	2.92E-08	NA
copper	5.92E-07	2.92E-09	NA
cumene	5.92E-06	2.92E-08	NA
cyanide	5.92E-07	2.92E-09	NA
dibenz(a,h)anthracene	8.88E-06	4.38E-08	1.33E-01
dibromochloromethane	5.92E-06	2.92E-08	4.22E-10
dichlorodifluoromethane	5.92E-06	2.92E-08	2.57E-10
dieldrin	2.96E-06	1.46E-08	1.78E-01
diethyl phthalate	5.92E-06	2.92E-08	NA
di-n-butylphthalate	5.92E-06	2.92E-08	NA
di-n-octylphthalate	5.92E-06	2.92E-08	NA
endosulfan	2.96E-06	1.46E-08	NA
endrin	2.96E-06	1.46E-08	NA
ethyl chloride	5.92E-06	2.92E-08	NA

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

$$\text{Intake Equation} = \text{CS} \times \text{CF} \times \text{EF} \times \text{ED} \times \text{AF} \times \text{ABS} \times \text{SA}$$

$$\text{BW} \times \text{AT}$$

SA	Surface area of exposed skin (50th percentile, hands only)	5800	cm ² /day
AF	Adherence Factor	1	mg/cm ²
ABS	Absorption factor (see table below)	csv	
CF	Conversion factor	1.0E-06	kg/mg
EF	Exposure frequency	90	d/year
EDn	Exposure duration for non-carcinogens	1	year
EDc	Exposure duration for carcinogens	1	year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	day
ATn	Average time for non-carcinogens (EDn x 365)	126	day
CS	Concentration of chemicals in soil (see table below)	csv	

Chemical Concentrations

Compound	ABS (unitless)	Concentration (mg/kg)	Compound	ABS (unitless)	Concentration (mg/kg)
ethylene	1.00E-01	1.00E+00	methylene bromide	1.00E-01	1.00E+00
fluoranthene	1.00E-01	1.00E+00	methylene chloride	1.00E-01	1.00E+00
fluorene	1.00E-01	1.00E+00	methoxy-tert-butyl ether	1.00E-01	1.00E+00
gamma-bhc	5.00E-02	1.00E+00	molybdenum	1.00E-02	1.00E+00
heptachlor	5.00E-02	1.00E+00	n-butylbenzyl phthalate	1.00E-01	1.00E+00
heptachlor epoxide	5.00E-02	1.00E+00	nickel	1.00E-02	1.00E+00
hexachlorobenzene	1.00E-01	1.00E+00	nitroaniline, o-	1.00E-01	1.00E+00
hexachlorobutadiene	1.00E-01	1.00E+00	nitrobenzene	1.00E-01	1.00E+00
hexachlorocyclopentadiene	1.00E-01	1.00E+00	nitrosodiphenylamine, p-	1.00E-01	1.00E+00
hexachloroethane	1.00E-01	1.00E+00	n-nitrosodimethylamine	1.00E-01	1.00E+00
indeno(1,2,1-d)pyrene	1.00E-01	1.00E+00	n-nitroso-di-p-propylamine	1.00E-01	1.00E+00
isobutyl alcohol	1.00E-01	1.00E+00	n-nitrosodiphenylamine	1.00E-01	1.00E+00
isophorone	1.00E-01	1.00E+00	o-chlorotoluene	1.00E-01	1.00E+00
mercury	1.00E-02	1.00E+00	p-chloro-m-cresol	1.00E-01	1.00E+00
methoxychlor	1.00E-01	1.00E+00			
methyl methacrylate	1.00E-01	1.00E+00			

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
ethylbenzene	5.92E-06	NA	1.64E-05	2.92E-08	NA	NA
fluoranthene	5.92E-06	3.60E-01	1.64E-05	2.92E-08	NA	NA
fluorene	5.92E-06	3.60E-01	1.64E-05	2.92E-08	NA	NA
gamma-bhc	2.96E-06	2.94E-03	1.01E-03	1.46E-08	1.12E+00	1.64E-08
heptachlor	2.96E-06	2.00E-04	1.48E-02	1.46E-08	1.43E+01	2.08E-07
heptachlor epoxide	2.96E-06	1.17E-05	2.53E-01	1.46E-08	1.44E+01	2.11E-07
hexachlorobenzene	5.92E-06	NA	NA	2.92E-08	2.00E+00	5.84E-08
hexachlorobutadiene	5.92E-06	NA	NA	2.92E-08	8.67E-02	2.53E-09
hexachlorocyclopentadiene	5.92E-06	6.30E-02	9.39E-05	2.92E-08	NA	NA
hexachloroethane	5.92E-06	9.00E-03	6.58E-04	2.92E-08	4.33E-02	1.26E-09
indeno(1,2,3-cd)pyrene	5.92E-06	NA	NA	2.92E-08	1.33E+00	3.89E-08
isobutyl alcohol	5.92E-06	2.70E+00	2.19E-06	2.92E-08	NA	NA
isophorone	5.92E-06	1.80E+00	3.29E-06	2.92E-08	1.06E-03	3.08E-11
mercury	5.92E-07	4.50E-05	1.32E-02	2.92E-09	NA	NA
methoxychlor	5.92E-06	4.50E-03	1.32E-03	2.92E-08	NA	NA
methyl methacrylate	5.92E-06	7.20E-02	8.22E-05	2.92E-08	NA	NA
methylene bromide	5.92E-06	9.00E-02	6.58E-05	2.92E-08	NA	NA
methylene chloride	5.92E-06	6.00E-02	9.86E-05	2.92E-08	1.40E-02	4.09E-10
methyl-tert-butyl ether	5.92E-06	NA	NA	2.92E-08	NA	NA
molybdenum	5.92E-07	1.52E-02	3.89E-05	2.92E-09	NA	NA
n-butylbenzyl phthalate	5.92E-06	1.80E-01	3.29E-05	2.92E-08	NA	NA
nickel	5.92E-07	1.00E-03	5.92E-04	2.92E-09	NA	NA
nitroaniline, o-	5.92E-06	NA	NA	2.92E-08	NA	NA
nitrobenzene	5.92E-06	4.50E-03	1.32E-03	2.92E-08	NA	NA
nitrosodiphenylamine, p-	5.92E-06	NA	NA	2.92E-08	2.44E-02	7.13E-10
n-nitrosodimethylamine	5.92E-06	NA	NA	2.92E-08	1.78E+01	5.19E-07
n-nitroso-di-n-propylamine	5.92E-06	NA	NA	2.92E-08	7.78E+00	2.27E-07
n-nitrosodiphenylamine	5.92E-06	NA	NA	2.92E-08	1.00E-02	2.92E-10
o-chlorotoluene	5.92E-06	1.80E-01	3.29E-05	2.92E-08	NA	NA
p-chloro-m-cresol	5.92E-06	1.80E+00	3.29E-06	2.92E-08	NA	NA

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Intake Equation = CS X CF X EF X ED X AF X ABS X SA
 BW X AT

SA	Surface area of exposed skin (50th percentile, hands only)	5800 cm ² /day
AF	Adherence Factor	1 mg/cm ²
ABS	Absorption factor (see table below)	csv
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	90 d/year
EDn	Exposure duration for non-carcinogens	1 year
EDc	Exposure duration for carcinogens	1 year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25530 day
ATn	Average time for non-carcinogens (EDn x 365)	126 day
CS	Concentration of chemicals in soil (see table below)	csv

Chemical Concentrations

Compound	ABS (unitless)	Concentration (mg/kg)	Compound	ABS (unitless)	Concentration (mg/kg)
pentachlorophenol	2.50E-01	1.00E+00	zinc	1.00E-02	1.00E+00
phenol	1.00E-01	1.00E+00			
Pyrene	1.50E-01	1.00E+00			
scelenium	1.00E-02	1.00E+00			
silver	1.00E-02	1.00E+00			
styrene	1.00E-01	1.00E+00			
terachloroethene	1.00E-01	1.00E+00			
toluene	1.00E-01	1.00E+00			
toxaphene	1.00E-01	1.00E+00			
trans-1,2-dichloroethene	1.00E-01	1.00E+00			
trichloroethene	1.00E-01	1.00E+00			
trichlorofluoromethane	1.00E-01	1.00E+00			
vandium	1.00E-02	1.00E+00			
vinyl acetate	1.00E-01	1.00E+00			
vinyl chloride	1.00E-01	1.00E+00			
xylenes	1.00E-01	1.00E+00			

Table B-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Dermal Contact with Soils

Compound	Non-Carcinogenic Calculation			
	CDI (mg/kg-d) 1.48E-05	RfD (mg/kg-d) 3.00E-02	UH (unitless)	4.93E-04
pentachlorophenol	5.92E-06	5.40E-01	1.10E-05	
phenol	8.88E-06	1.29E-01	6.88E-05	
pyrene	5.92E-07	4.85E-03	1.22E-04	
selenium	5.92E-07	1.05E-03	5.64E-04	
silver	5.92E-06	NA	NA	
styrene	5.92E-06	9.00E-02	6.58E-05	
tetrachloroethene	5.92E-06	2.00E+00	2.96E-06	
toluene	5.92E-06	NA	NA	
toxaphene	5.92E-06	NA	NA	
trans-1,2-dichloroethene	5.92E-06	1.80E-01	3.29E-05	
trichloroethene	5.92E-06	NA	NA	
trichlorofluoromethane	5.92E-06	6.30E-01	9.39E-06	
vanadium	5.92E-07	3.50E-04	1.69E-03	
vinyl acetate	5.92E-06	9.00E-01	6.58E-06	
vinylyl chloride	5.92E-06	NA	NA	
xylenes	5.92E-06	1.80E+00	3.29E-06	
zinc	5.92E-07	9.00E-02	6.58E-06	

Compound	CDI (mg/kg·d)	CSF (mg/kg·d) ¹	Carcinogenic Calculation	UR (unitless)
pentachlorophenol	7.30E-08	1.80E-02		1.31E-09
phenol	2.92E-08	NA		NA
pyrene	4.38E-08	NA		NA
selenium	2.92E-09	NA		NA
silver	2.92E-09	NA		NA
styrene	2.92E-08	NA		NA
tetrachloroethene	2.92E-08	5.67E-02		1.65E-09
toluene	2.92E-08	NA		NA
toxaphene	2.92E-08	1.33E+00		3.89E-08
trans-1,2-dichloroethene	2.92E-08	NA		NA
trichloroethene	2.92E-08	1.53E-02		4.47E-10
trichlorofluoromethane	2.92E-08	NA		NA
vanadium	2.92E-09	NA		NA
vinyl acetate	2.92E-08	NA		NA
vinyl chloride	2.92E-08	3.00E-01		8.76E-09
xylenes	2.92E-08	NA		NA
zinc	2.92E-09	NA		NA

Appendix C

Table C-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Intake Equation	=	CS X (1/VF + 1/PEF) X .EE X ED X ET X IR BW X AT					
IR	Inhalation rate of gases (RAGS, 1989)	2.5E+00 m³/h					
EF	Exposure frequency	9.0E+01 days/year					
EDn	Exposure duration for non-carcinogens	1.0E+00 year					
EDc	Exposure duration for carcinogens	1.0E+00 year					
BW	Body weight	7.0E+01 kg					
ATc	Average time for carcinogens (lifetime)	2.6E+04 days					
ATn	Average time for non-carcinogens (EDn x 365)	1.3E+02 days					
ET	Exposure time	8.0E+00 h/d					
CS	Concentration of chemicals in soil	(see table below)					
VF	Volatilization Factor	(see table below)					
PEF	Particulate Emission Factor	(see table below)					
Chemical Concentrations							
Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)	Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)
1-butanol	3.9E+04	4.8E+09	1.0E+00	2-butane	2.0E+05	4.8E+09	1.0E+00
1,1-dichlorethane	4.5E+04	4.8E+09	1.0E+00	2-chlorophenol	1.1E+06	4.8E+09	1.0E+00
1,1-dichloroethene	4.1E+04	4.8E+09	1.0E+00	2-methylphenol	2.7E+06	4.8E+09	1.0E+00
1,1,1,2-tetrachloroethane	3.6E+05	4.8E+09	1.0E+00	2-naphthylamine	3.2E+07	4.8E+09	1.0E+00
1,1,2-trichloroethane	1.8E+05	4.8E+09	1.0E+00	2,4-dichlorophenol	6.0E+06	4.8E+09	1.0E+00
1,1,2,2-tetrachloroethane	3.8E+05	4.8E+09	1.0E+00	2,4-dimethylphenol	1.0E+07	4.8E+09	1.0E+00
1,2-dibromo-3-chloropropane	4.3E+05	4.8E+09	1.0E+00	2,4-dinitrophenol	1.3E+08	4.8E+09	1.0E+00
1,2-dibromomethane	1.3E+05	4.8E+09	1.0E+00	2,4-dinitrotoluene	2.9E+07	4.8E+09	1.0E+00
1,2-dichlorobenzene	4.7E+05	4.8E+09	1.0E+00	2,4,5-trichlorophenol	3.3E+06	4.8E+09	1.0E+00
1,2-dichlorethane	8.0E+04	4.8E+09	1.0E+00	2,4,6-trichlorophenol	1.6E+07	4.8E+09	1.0E+00
1,2-dichloropropane	9.3E+03	4.8E+09	1.0E+00	2,6-dinitrotoluene	1.0E+07	4.8E+09	1.0E+00
1,2-diphenylhydrazine	2.7E+08	4.8E+09	1.0E+00	3,3-dichlorobenzidine	5.6E+08	4.8E+09	1.0E+00
1,2,3-trichloropropane	3.2E+05	4.8E+09	1.0E+00	4-chloraniline	2.8E+06	4.8E+09	1.0E+00
1,2,4-trichlorobenzene	2.0E+06	4.8E+09	1.0E+00	4-methyl-2-pentanone	3.8E+05	4.8E+09	1.0E+00
1,3-dichloropropene	1.1E+05	4.8E+09	1.0E+00				
1,4-dichlorobenzene	7.8E+05	4.8E+09	1.0E+00				

Table C-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d)
1-butanol	5.2E-06	1.0E+00	5.2E-06	1-butanol	2.6E-08	NA
1,1-dichloroethane	4.5E-06	1.4E+00	3.1E-06	1,1-dichloroethane	2.2E-08	5.7E-03
1,1-dichloroethene	5.0E-06	9.0E-03	5.6E-04	1,1-dichloroethene	2.5E-08	1.2E+00
1,1,1,2-tetrachloroethane	5.7E-07	3.0E-02	1.9E-05	1,1,1,2-tetrachloroethane	2.8E-09	2.6E-02
1,1,2-trichloroethane	1.2E-06	4.0E-02	2.9E-05	1,1,2-trichloroethane	5.7E-09	7.2E-02
1,1,2,2-tetrachloroethane	5.4E-07	NA	NA	1,1,2,2-tetrachloroethane	2.7E-09	2.7E-01
1,2-dibromo-3-chloropropane	4.8E-07	5.7E-05	8.4E-03	1,2-dibromo-3-chloropropane	2.4E-09	7.0E+00
1,2-dibromoethane	1.6E-06	5.7E-04	2.8E-03	1,2-dibromoethane	8.0E-09	2.5E-01
1,2-dichlorobenzene	4.3E-07	NA	NA	1,2-dichlorobenzene	2.1E-09	NA
1,2-dichloroethane	2.6E-06	NA	NA	1,2-dichloroethane	1.3E-08	7.0E-02
1,2-dichloropropane	2.2E-05	3.7E-03	5.9E-03	1,2-dichloropropane	1.1E-07	6.3E-02
1,2-diphenylhydrazine	8.1E-10	NA	NA	1,2-diphenylhydrazine	4.0E-12	8.7E-01
1,2,3-trichloropropane	6.5E-07	6.0E-02	1.1E-05	1,2,3-trichloropropane	3.2E-09	7.0E+00
1,2,4-trichlorobenzene	1.0E-07	5.7E-01	1.8E-07	1,2,4-trichlorobenzene	5.0E-10	NA
1,3-dichloropropene	1.8E-06	5.7E-03	3.2E-04	1,3-dichloropropene	9.0E-09	5.5E-02
1,4-dichlorobenzene	2.6E-07	7.1E-01	3.7E-07	1,4-dichlorobenzene	1.3E-09	4.0E-02
2-butanone	1.0E-06	2.9E+00	3.6E-07	2-butanone	5.0E-09	NA
2-chlorophenol	1.9E-07	5.0E-02	3.8E-06	2-chlorophenol	9.4E-10	NA
2-methylphenol	7.5E-08	5.0E-01	1.5E-07	2-methylphenol	3.7E-10	NA
2-naphthylamine	6.4E-09	NA	NA	2-naphthylamine	3.2E-11	1.8E+00
2,4-dichlorophenol	3.4E-08	3.0E-03	1.1E-05	2,4-dichlorophenol	1.7E-10	NA
2,4-dimethylphenol	2.0E-08	2.0E-01	9.9E-08	2,4-dimethylphenol	9.8E-11	NA
2,4-dinitrophenol	1.6E-09	1.6E-01	7.9E-07	2,4-dinitrophenol	7.8E-12	NA
2,4-dinitrotoluene	7.2E-09	2.0E-03	3.6E-06	2,4-dinitrotoluene	3.5E-11	3.1E-01
2,4,5-trichlorophenol	6.2E-08	1.0E+00	6.2E-08	2,4,5-trichlorophenol	3.1E-10	NA
2,4,6-trichlorophenol	1.2E-08	NA	NA	2,4,6-trichlorophenol	6.2E-11	7.0E-02
2,6-dinitrotoluene	2.0E-08	1.0E-02	2.0E-06	2,6-dinitrotoluene	9.8E-11	6.8E-01
3,3-dichlorobenzidine	4.1E-10	NA	NA	3,3-dichlorobenzidine	2.0E-12	1.2E+00
4-chloraniline	7.3E-08	4.0E-03	1.8E-05	4-chloraniline	3.6E-10	NA
4-methyl-2-pentanone	5.3E-07	2.3E-01	2.3E-06	4-methyl-2-pentanone	2.6E-09	NA

Table C-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Intake Equation	=	CS X (1/VF + 1/PEF) X_EF X_ED X ET X_IR BW X AT
IR	Inhalation rate of gases (RAGS, 1989)	2.5E+00 m³/h
EF	Exposure frequency	9.0E+01 days/year
ED _n	Exposure duration for non-carcinogens	1.0E+00 year
ED _c	Exposure duration for carcinogens	1.0E+00 year
BW	Body weight	7.0E+01 kg
AT _c	Average time for carcinogens (lifetime)	2.6E+04 days
AT _{In}	Average time for non-carcinogens (ED _n x 365)	1.3E+02 days
ET	Exposure time	8.0E+00 h/d (see table below)
CS	Concentration of chemicals in soil	Particulate Emission Factor (see table below)
VF	Volatilization Factor	Particulate Emission Factor (see table below)
PEF	Particulate Emission Factor	
Chemical Concentrations		
Compound	VF (m³/kg)	PEF (m³/kg)
4-methylphenol	6.3E+06	1.0E+00
4,4-ddd	2.9E+08	4.8E+09
4,4-dde	1.8E+07	1.0E+00
4,4-ddt	1.6E+08	4.8E+09
acenaphthene	3.6E+06	1.0E+00
acetone	1.5E+05	4.8E+09
acrolein	2.6E+05	4.8E+09
acrylonitrile	1.6E+05	1.0E+00
aldrin	1.3E+07	4.8E+09
alpha-bhc	2.3E+07	1.0E+00
aniline	1.3E+07	4.8E+09
anthracene	1.5E+07	1.0E+00
antimony	NA	4.8E+09
aroclor 1016	7.2E+06	1.0E+00
aroclor 1254	1.2E+07	4.8E+09
arsenic	NA	1.0E+00
Compound		
barium	NA	4.8E+09
benzene	7.6E+04	4.8E+09
benzidine	5.2E+06	4.8E+09
benzoic acid	9.0E+06	4.8E+09
benzo(a)anthracene	3.9E+08	4.8E+09
benzo(a)pyrene	3.6E+08	4.8E+09
benzo(b)fluoranthene	2.1E+08	4.8E+09
benzo(k)fluoranthene	1.1E+08	4.8E+09
benzyl alcohol	2.5E+06	4.8E+09
benzyl chloride	4.9E+05	4.8E+09
beryllium	NA	4.8E+09
beta-bhc	7.9E+07	4.8E+09
beta-chloronaphthalene	1.2E+06	4.8E+09
bis(2-chloro-1-methylethyl)et	6.0E+05	4.8E+09

Table C-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RID (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
4-methylphenol	3.3E-08	5.0E-03	6.5E-06	1.6E-10	NA	NA
4,4-ddd	7.5E-10	NA	NA	3.7E-12	2.4E-01	8.9E-13
4,4-dde	1.1E-08	NA	NA	5.5E-11	3.4E-01	1.9E-11
4,4-ddt	1.3E-09	5.0E-04	2.6E-06	6.4E-12	3.4E-01	2.2E-12
acenaphthene	5.6E-08	6.0E-01	9.4E-08	2.8E-10	NA	NA
acetone	1.4E-06	1.0E+00	1.4E-06	6.9E-09	NA	NA
acrolein	7.8E-07	NA	NA	3.8E-09	NA	NA
acrylonitrile	1.3E-06	1.0E-02	1.3E-04	6.2E-09	1.0E+00	6.2E-09
aldrin	1.6E-08	3.0E-05	5.3E-04	7.8E-11	1.7E+01	1.3E-09
alpha-bhc	9.1E-09	NA	NA	4.5E-11	6.3E+00	2.8E-10
aniline	1.6E-08	2.9E-04	5.4E-05	7.6E-11	5.7E-03	4.4E-13
anthracene	1.4E-08	3.0E-01	4.6E-08	6.8E-11	NA	NA
antimony	4.3E-11	4.0E-04	1.1E-07	2.1E-13	NA	NA
aroclor 1016	2.9E-08	NA	NA	1.4E-10	NA	NA
aroclor 1254	1.7E-08	5.0E-05	3.5E-04	8.6E-11	NA	NA
arsenic	4.3E-11	3.0E-04	1.4E-07	2.1E-13	1.2E+01	2.5E-12
barium	4.3E-11	1.4E-03	3.0E-08	2.1E-13	NA	NA
benzene	2.7E-06	NA	NA	1.3E-08	1.0E-01	1.3E-09
benzidine	3.9E-08	3.0E-03	1.3E-05	1.9E-10	5.0E+02	9.7E-08
benzoic acid	2.3E-08	4.0E+00	5.7E-09	1.1E-10	NA	NA
benzo(a)anthracene	5.6E-10	NA	NA	2.8E-12	3.9E-01	1.1E-12
benzo(a)pyrene	6.1E-10	NA	NA	3.0E-12	3.9E+00	1.2E-11
benzo(b)fluoranthene	1.0E-09	NA	NA	5.0E-12	3.9E-01	2.0E-12
benzo(k)fluoranthene	1.8E-09	NA	NA	9.0E-12	3.9E-01	3.5E-12
benzyl alcohol	8.2E-08	1.0E+00	8.2E-08	4.0E-10	NA	NA
benzyl chloride	4.2E-07	NA	NA	2.1E-09	1.7E-01	3.5E-10
beryllium	4.3E-11	5.0E-03	8.5E-09	2.1E-13	8.4E+00	1.8E-12
beta-bhc	2.6E-09	NA	NA	1.3E-11	1.8E+00	2.3E-11
beta-chloronaphthalene	1.7E-07	NA	NA	8.5E-10	NA	NA
bis(2-chloro-1-methylethyl)ether	3.4E-07	NA	NA	1.7E-09	3.5E-02	5.9E-11

Table C-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Intake Equation	=	CS X ((VF + 1/PEF) X EF X ED X ET X IR BW X AT)					
IR	Inhalation rate of gases (RAGS, 1989)	2.5E+00 m³/h					
EF	Exposure frequency	9.0E+01 days/year					
EDn	Exposure duration for non-carcinogens	1.0E+00 year					
EDc	Exposure duration for carcinogens	1.0E+00 year					
BW	Body weight	7.0E+01 kg					
ATc	Average time for carcinogens (lifetime)	2.6E+04 days					
ATn	Average time for non-carcinogens (EDn x 365)	1.3E+02 days					
ET	Exposure time	8.0E+00 h/d (see table below)					
CS	Concentration of chemicals in soil	(see table below)					
VF	Volatilization Factor	(see table below)					
PEF	Particulate Emission Factor	(see table below)					
Chemical Concentrations							
Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)	Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)
bis(2-chloroethyl)ether	7.8E+05	4.8E+09	1.0E+00	cis-1,2-dichloroethene	6.0E+04	4.8E+09	1.0E+00
bis(2-ethylhexyl)phthalate	1.0E+08	4.8E+09	1.0E+00	copper	NA	4.8E+09	1.0E+00
bromodichloromethane	3.6E+05	4.8E+09	1.0E+00	cumene	3.3E+05	4.8E+09	1.0E+00
bromoform	4.2E+05	4.8E+09	1.0E+00	cyanide	NA	4.8E+09	1.0E+00
bromomethane	1.8E+04	4.8E+09	1.0E+00	dibenzof[a,h]anthracene	3.0E+10	4.8E+09	1.0E+00
cadmium	NA	4.8E+09	1.0E+00	dibromochloromethane	7.0E+04	4.8E+09	1.0E+00
carbazole	6.8E+07	4.8E+09	1.0E+00	dichlorodifluoromethane	4.4E+03	4.8E+09	1.0E+00
carbon disulfide	4.0E+04	4.8E+09	1.0E+00	diethyltin	1.1E+07	4.8E+09	1.0E+00
carbon tetrachloride	8.3E+04	4.8E+09	1.0E+00	diethyl phthalate	6.1E+06	4.8E+09	1.0E+00
chlorodane	8.0E+06	4.8E+09	1.0E+00	di-n-butyl phthalate	4.5E+06	4.8E+09	1.0E+00
chlorobenzene	1.5E+05	4.8E+09	1.0E+00	di-n-octyl phthalate	6.6E+07	4.8E+09	1.0E+00
chloroform	7.9E+04	4.8E+09	1.0E+00	endosulfan	1.3E+07	4.8E+09	1.0E+00
chromomethane	1.0E+04	4.8E+09	1.0E+00	endrin	4.7E+07	4.8E+09	1.0E+00
chromium iii	NA	4.8E+09	1.0E+00	ethyl chloride	5.1E+04	4.8E+09	1.0E+00
chromium vi	NA	4.8E+09	1.0E+00				
chrysene	8.3E+08	4.8E+09	1.0E+00				

Table C-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RID (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
bis(2-chloroethyl)ether	2.6E-07	NA	NA	1.3E-09	2.5E+00	3.2E-09
bis(2-ethylhexyl)phthalate	2.0E-09	NA	NA	1.0E-11	8.4E-03	8.4E-14
bromodichloromethane	5.6E-07	2.0E-02	2.8E-05	2.8E-09	1.3E-01	3.6E-10
bromoform	4.9E-07	2.0E-02	2.4E-05	2.4E-09	3.9E-03	9.4E-12
bromomethane	1.1E-05	NA	NA	5.6E-08	NA	NA
cadmium	4.3E-11	5.0E-04	8.5E-08	2.1E-13	1.5E+01	3.2E-12
carbazole	3.0E-09	NA	NA	1.5E-11	2.0E-02	3.0E-13
carbon disulfide	5.1E-06	2.0E-01	2.5E-05	2.5E-08	NA	NA
carbon tetrachloride	2.5E-06	NA	NA	1.2E-08	1.5E-01	1.8E-09
chlorodane	2.5E-08	6.0E-05	4.2E-04	1.3E-10	1.2E+00	1.5E-10
chlorobenzene	1.3E-06	NA	NA	6.5E-09	NA	NA
chloroform	2.6E-06	1.0E-02	2.6E-04	1.3E-08	1.9E-02	2.4E-10
chloromethane	2.0E-05	NA	NA	9.7E-08	6.3E-03	6.1E-10
chromium iii	4.3E-11	1.0E+00	4.3E-11	2.1E-13	NA	NA
chromium vi	4.3E-11	2.0E-02	2.1E-09	2.1E-13	5.1E+02	1.1E-10
chrysene	2.9E-10	NA	NA	1.4E-12	3.9E-02	5.6E-14
cis-1,2-dichloroethene	3.4E-06	1.0E-01	3.4E-05	1.7E-08	NA	NA
copper	4.3E-11	3.7E-02	1.2E-09	2.1E-13	NA	NA
cumene	6.2E-07	2.6E-02	2.4E-05	3.1E-09	NA	NA
cyanide	4.3E-11	2.0E-02	2.1E-09	2.1E-13	NA	NA
dibenzo(a,h)anthracene	5.0E-11	NA	NA	2.4E-13	4.1E+00	1.0E-12
dibromochloromethane	2.9E-06	2.0E-01	1.5E-05	1.4E-08	9.4E-02	1.4E-09
dichlorodifluoromethane	4.6E-05	5.7E-01	8.1E-05	2.3E-07	NA	NA
dieldrin	1.8E-08	5.0E-05	3.6E-04	8.9E-11	1.6E+01	1.4E-09
diethyl phthalate	3.4E-08	8.0E+00	4.2E-09	1.7E-10	NA	NA
di-n-butylphthalate	4.5E-08	1.0E+00	4.5E-08	2.2E-10	NA	NA
di-n-octyphthalate	3.1E-09	2.0E-02	1.6E-07	1.5E-11	NA	NA
endosulfan	1.6E-08	6.0E-03	2.6E-06	7.6E-11	NA	NA
endrin	4.4E-09	3.0E-04	1.5E-05	2.2E-11	NA	NA
ethyl chloride	4.0E-06	2.9E+00	1.4E-06	2.0E-08	NA	NA

TABLE 2-6 (CONT.)

Constituent	Chronic/Subchronic Exposures		
	GI Absorption	Oral (mg/kg-d) ⁻¹	Dermal (mg/kg-d) ⁻¹
pyrene	4.30E-01	NA	NA
selenium	9.70E-01	NA	NA
silver	2.10E-01	NA	NA
styrene	9.00E-01	NA	NA
tetrachloroethene	9.00E-01	5.10E-02	2.10E-02
toluene	1.00E+00	NA	NA
toxaphene	9.00E-01	1.20E+00	1.20E+00
trans-1,2-dichloroethene	9.00E-01	NA	NA
trichloroethene	9.80E-01	1.50E-02	1.00E-02
trichlorofluoromethane	9.00E-01	NA	NA
vanadium	5.00E-02	NA	NA
vinyl acetate	9.00E-01	NA	NA
vinyl chloride	9.00E-01	2.70E-01	2.70E-01
xylenes	9.00E-01	NA	NA
zinc	3.00E-01	NA	NA

NOTES:

NA = Not Available. No toxicity data exist for pathway.

SOURCES:

Dermal Exposure Assessment (EPA 1992)
 California Cancer Potency Factors Update (Cal/EPA 1996)
 IRIS (EPA 1997)
 HEAST (EPA 1995)

3. DEVELOPMENT OF THE CONCEPTUAL EXPOSURE MODEL

This section describes the projected exposures associated with the final land use of Parcel A as a commercial facility and with an intermediate scenario representing construction of the facility. The general post-remediation setting for the two exposure scenarios is described first (Section 3.1), followed by a site-specific conceptual exposure model (CEM) which traces the pathways of exposure from constituent source to potentially exposed populations or "receptors" (Section 3.2). Section 3 forms the basis for the subsequent quantification of potential human health impacts.

Development of the post-remediation exposure setting and CEM for Parcel A followed standard agency guidance, including the Risk Assessment Guidance for Superfund (RAGS) Human Health Evaluation Manual, Volume I (EPA 1989a) and Data Quality Objectives Guidance for Superfund (EPA 1993). When available, MDRC-generated site-specific information was used, supplemented with information obtained from the International Light Metals (ILM) Baseline Risk Assessment recently approved by DTSC for the adjacent Lockheed Martin property (G&M 1996). The Parcel A CEM is based on conservative assumptions; with the understanding that the parcel will be developed into a commercial/industrial facility.

3.1 POST-REMEDIATION EXPOSURE SETTING

The specific characteristics of the post-remediation exposure setting influence the availability of constituents to potential receptors, release mechanisms, exposure routes, and receptor activities. A receptor's actual exposure depends on the physical attributes of the site and land use. Traditionally, before developing a CEM, the fundamental site characteristics are established. These characteristics include climate, lithology, hydrology, future land use, and the levels of conservatism necessary to ensure health protection in accordance with the proposed land use.

This report incorporates the unit risk approach, which is chemical- and receptor-specific and does not rely on factors such as lithology and hydrology. These factors are included only when the fate and transport models used in the evaluation of indirect exposure pathways require it. While discussions of lithology, hydrology, and climate are not necessary for this document, the definition of future land use and the use of conservative indicators of potential future exposures are assessed.

3.1.1 Future Land Use and Associated Exposure Scenarios

As mentioned, for the purpose of defining potential receptor exposures, this report assumes a single future land use for Parcel A - a commercial/industrial facility. Given this land use, two post-remediation exposure scenarios are examined, one associated with construction of the facility (the *construction scenario*), the other associated with its operation (the *commercial/industrial scenario*).

The envisioned commercial/industrial facility is consistent with existing zoning. While final decisions concerning the exact building layout and business uses of Parcel A have not been made, reasonable and conservative assumptions concerning potential commercial/industrial uses have been used to develop the receptor exposure scenarios. As such, the estimated exposures are considered conservative. In developing the exposure scenarios, it was assumed that:

- During construction, access controls will be in place; security will minimize trespassing.
- The developed site will not have access controls.
- Within Parcel A, all surfaces will be capped with cement or asphalt (for building foundations, roadways, and parking areas) or covered with vegetation (landscaping).
- All construction activities will be completed within 1 year.

3.1.2 Reasonable Maximum Exposure

Populations potentially affected by site constituents include persons of various ages and lifestyles who live or conduct business at or near the site. Instead of estimating the health impacts to a specific individual, this report focuses on the evaluation of potential health effects to representative receptor groups.

EPA recommends the use of the reasonable maximum exposure (RME) to express the highest exposure that could reasonably occur at the site (EPA 1989a). RME is conservative, within the range of possible exposures but higher than the typical or average exposure. Furthermore, RME is estimated for individual pathways. If a population is exposed to more than one pathway, then the sum of the exposures across pathways also represents the RME (EPA 1989a).

In calculating exposure, EPA (1989a) suggests that specific values for each parameter in the exposure equation be combined to generate the RME. These parameters include the following:

Parameter	Recommended RME Approach
Intake Rate	Upper 95th percentile
Exposure Frequency and Duration	Upper 95th percentile estimate or develop an alternate conservative value
Body Weight	Arithmetic average over exposure period

If the upper 95th percentile is unavailable, the upper 90th percentile may be substituted (EPA 1989a).

3.2 CONCEPTUAL EXPOSURE MODEL

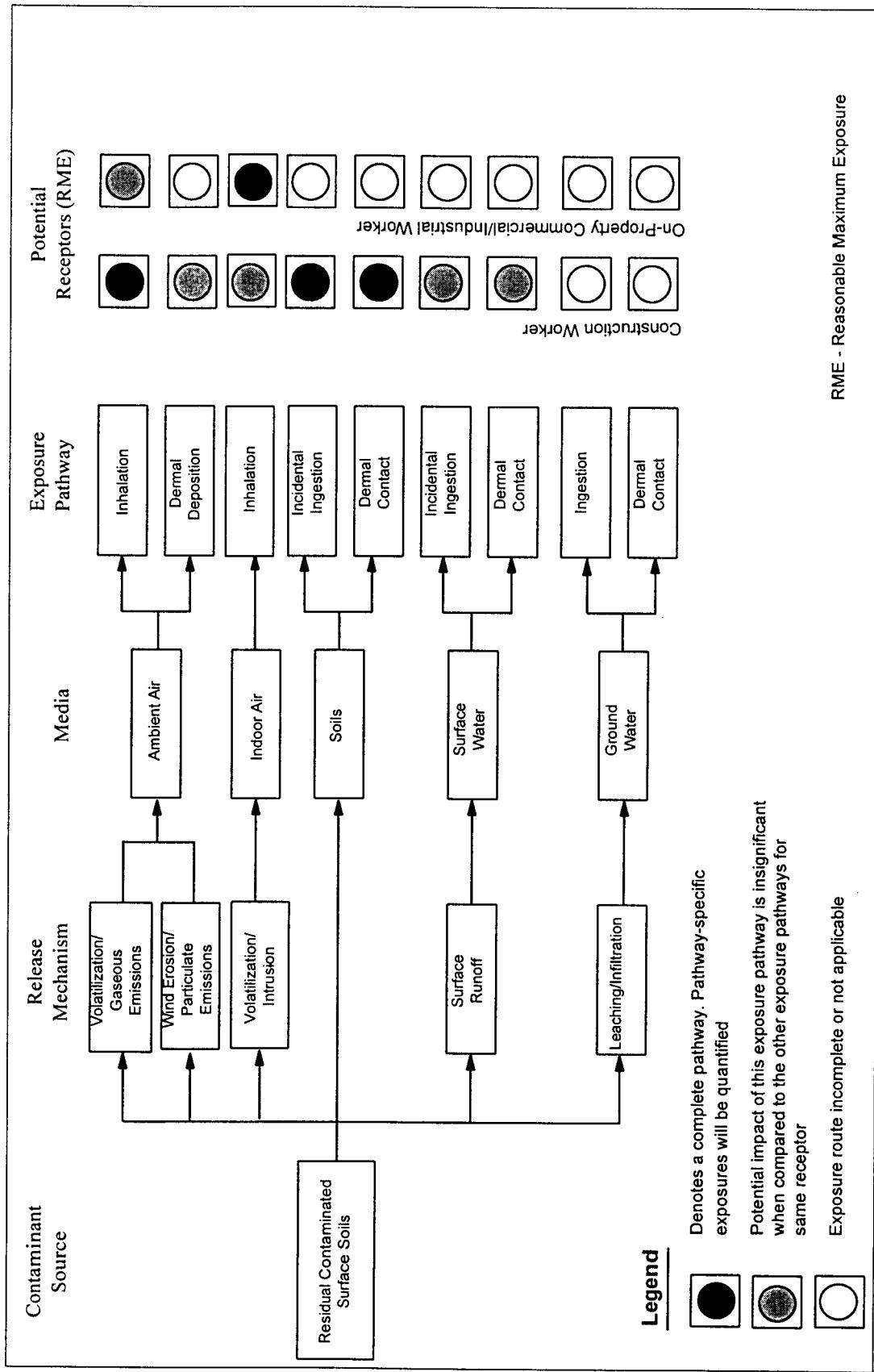
Given the construction and commercial/industrial exposure scenarios, there are several pathways through which a potential receptor can come in contact with site constituents. Prior to the quantification of exposure, each pathway must be reviewed to determine the validity and/or completeness of potential future exposures. For an exposure pathway to be considered complete, the following essential elements must be present:

- Contaminant source
- Release mechanism
- Transport medium
- Exposure pathway
- Exposed population or receptor

Figure 3-1 is the conceptual exposure model (CEM) developed to describe the Parcel A exposure setting after remediation, under the construction and commercial/industrial scenarios. The CEM provides the basis for a comprehensive evaluation of the risks to human health by creating a framework for identifying the mechanisms through which receptors may be exposed to residual constituents. As shown in the figure, the CEM traces the constituents in a logical flow from their sources through release mechanisms and exposure routes to the potentially affected receptors.

Of particular importance, the CEM identifies which exposure routes are complete and significant for the given receptors. The model also facilitates the analysis and screening of exposure pathways that are likely to pose only minor risks. The following sections provide details on these subjects.

FIGURE 3-1
CONCEPTUAL EXPOSURE MODEL
C-6 FACILITY, PARCEL A



3.2.1 Contaminant Sources

Identification of contaminant sources involves the characterization of the exposure setting with respect to the general physical characteristics of the site and, in particular, the impact of those characteristics on the contamination for the various media present at the site. The medium of concern identified for the C-6 facility is soil. Groundwater has been excluded from further evaluation because it is nonpotable (RWQCB 1996, G&M 1996). This information was used to refine the CEM and identify potential exposure pathways and receptors (Figure 3-1).

3.2.2 Release Mechanisms

The CEM outlines the residual on-property sources following the completion of remedial actions. Under the proposed land use, several mechanisms could facilitate the direct or indirect exposure of receptors. Three primary release mechanisms are commonly responsible for the release of constituents in soils: leaching/infiltration, volatilization, and resuspension of particulate.

The potential release mechanisms at the site are volatilization and resuspension. Releases to air may occur through the generation of particulate by wind or surface soil disturbances. In addition, gaseous phase constituents may be released through volatilization.

Under current and proposed conditions, there is expected to be little or no migration of constituents from groundwater to air. The distance from groundwater to land surface (65 to 70 feet) makes it very unlikely that volatilization and migration of constituents in groundwater would result in atmospheric concentrations at measurable levels.

Figure 3-1 shows how the release mechanisms fit into the overall CEMs.

3.2.3 Transport Media

Conceptually, once a constituent is released to the environment, it travels via the transport pathways through the various environmental media to points of contact with potential receptors (Figure 3-1). As stated, the medium of concern identified for the C-6 facility is soil.

The potential for volatile emissions from soils is anticipated to continue under the proposed exposure scenarios. This will include the diffusion of volatile constituents indoors. Exposures resulting from resuspended particulate matter will cease, as the entire site will be paved, landscaped and built-out for commercial/industrial uses.

3.2.4 Significant Exposure Pathways

Not all release mechanisms lead to significant exposure pathways under the previously discussed exposure scenarios. This section discusses the significance of each exposure pathway shown in Figure 3-1.

3.2.4.1 Inhalation Exposure Pathways

Exposures via the inhalation pathways consist of constituents transported by air eventually reaching a receptor who inhales airborne gases and suspended particulate. Inhalation of gas and suspended particulate is significant for the construction worker receptor as a result of construction activities and the proximity to residual sources (Figure 3-1). The commercial/industrial user may also be exposed to gaseous indoor air concentrations (Figure 3-1). Under the commercial/industrial scenario, particulate exposures will be eliminated by the developed commercial/industrial complex.

3.2.4.2 Dermal Contact Exposure Pathways

This group of pathways encompasses all receptor activities that result in direct contact with constituents in soil. Under the construction scenario there will be a significant opportunity for dermal exposure to soil.

Residual concentrations of constituents in the surface soil (to 12 feet bgs) pose a potential for exposure during construction. The potential for dermal exposure at the completed commercial/industrial development will be eliminated through the construction of parking areas, buildings, and associated landscaping.

3.2.4.3 Ingestion Exposure Pathways

The incidental ingestion of soil is a common exposure pathway for many receptors. Under the construction scenario, potential receptors will be readily exposed to residual soil constituents. This is likely to facilitate dermal exposure and subsequent incidental ingestion. Under the commercial/industrial scenario, exposure will be eliminated through the construction of parking areas, buildings, and associated landscaping.

3.2.5 Potentially Exposed Populations

The identification of potential receptors involves the evaluation of the construction and commercial/industrial land-use scenarios and the characterization of populations on or near the site with respect to activity patterns based on those land uses. This includes identifying those populations that are the closest to or actually working on the site and therefore have the greatest potential for exposure. Detailed descriptions of the type, location, and lifestyle of the populations with significant exposure potential are provided below.

3.2.5.1 Construction Worker

This RME receptor represents the full-time employees of the construction firms contracted to develop the commercial/industrial facility. Under the construction scenario, the construction worker is assumed to work at the site eight hours a day, five days a week. Three significant exposure pathways are applicable to this receptor under this land-use scenario:

- Inhalation of volatilized constituents and resuspended particulate (ambient air)
- Incidental ingestion of soil
- Dermal contact with soil

Ingestion of groundwater drawn from the underlying Gage Aquifer is not applicable to this receptor since all on-site water needs during construction activities will be provided by the local municipality or off-site sources.

3.2.5.2 Commercial/Industrial User

This RME receptor represents the full-time employees of the commercial/industrial facilities developed on site, as well as visitors or customers who could receive exposures while visiting or conducting brief business activities at the site. Under the commercial/industrial scenario, the commercial/industrial user is assumed to work at the site eight hours a day, five days a week. Only one significant exposure pathway is applicable to this receptor under this land-use scenario:

- Inhalation of volatilized constituents (indoor air)

Ingestion of groundwater drawn from the underlying Gage Aquifer is not applicable to this receptor since all on-site commercial/industrial water needs will be provided by the local municipality.

4. CALCULATION OF UNIT RISK

Section 4 presents the calculation of unit risk and unit toxicity for the identified complete exposure pathways. Calculating unit risk is identical to calculating incremental lifetime cancer risk (ILCR) and/or a hazard index (HI), except that for unit risk a unit value of 1.0 replaces the source term exposure point concentration (1.0 kg/mg for direct exposures and modeled unit emissions for indirect exposures).

The unit risk calculations presented here quantify the magnitude, frequency, and duration of exposure for those populations and exposure pathways selected for quantitative evaluation in the conceptual exposure model (CEM). Section 3 describes the CEM. The following sections give standard equations for estimating human intake and subsequent risk for the selected exposure pathways. A sample calculation is included for each quantification method.

Unless otherwise noted, the parameters and equations used in this section are drawn from the Risk Assessment Guidance for Superfund (RAGS) Human Health Evaluation Manual, Volume I (EPA 1989a) and the Exposure Factors Handbook (EPA 1990b). When available, MDRC-generated site-specific values are used, supplemented with site-specific values obtained from the International Light Metals (ILM) Baseline Risk Assessment recently approved by DTSC for the adjacent Lockheed Martin property (G&M 1996). Exposure parameters for each receptor under study are presented in Table 4-1, while constituent-specific dermal absorption values are presented in Table 4-2. These two tables are referenced extensively in the following sections.

Two types of exposure pathway are identified in the CEM and quantified in this document:

- Direct exposure pathways, such as incidental soil ingestion, in which the receptor comes in direct contact with the source medium; Section 4.1 quantifies these risks.
- Indirect exposure pathways, such as soil-to-air volatilization, in which exposure occurs away from or in a different medium from the source; Section 4.2 quantifies the risks.

The methodology used to quantify receptor-specific unit risk values must account for these differences. The aggregate risk for a receptor, or the sum of exposures from all applicable pathways, is presented in Section 4.3.

TABLE 4-1
EXPOSURE PARAMETERS

Pathway	Parameter	Construction Worker	Commercial/ Industrial User
Ingestion	IR - Ingestion Rate (mg/d)	480 (ILM)	NA
	EF - Exposure Frequency (d/y)	90 (ILM)	NA
	ED - Exposure Duration (y)	1	NA
	BW - Body Weight (kg)	70	NA
	AT - Averaging Time - car. (d)	25,550	NA
	AT - Averaging Time - noncar. (d)	126 (ILM)	NA
	CF - Conversion Factor (kg/mg)	1×10^{-6}	NA
Dermal Contact	SA - Skin Surface Area (cm ² / d)	5800 (ILM)	NA
	AF - Soil to Skin Adherence Factor (mg/cm ²)	1	NA
	ABS- Absorption Factor (unitless)	csv	NA
	EF - Exposure Frequency (d/y)	90 (ILM)	NA
	ED - Exposure Duration (y)	1	NA
	BW - Body Weight (kg)	70	NA
	AT - Averaging Time - car. (d)	25,550	NA
Inhalation	AT - Averaging Time - noncar. (d)	126 (ILM)	NA
	CF - Conversion Factor (kg/mg)	1×10^{-6}	NA
	IH - Inhalation Rate (m ³ /h)	2.5	0.83
	ET - Exposure Time (h/d)	8	8
	EF - Exposure Frequency (d/y)	90	250
	ED - Exposure Duration (y)	1	25
	AT - Averaging Time - car. (d)	25,550	25,550
	AT - Averaging Time - noncar. (d)	126 (ILM)	9,125

NOTES:

car. = carcinogenic
 noncar. = noncarcinogenic
 csv = chemical specific value
 ILM = Value used in the adjacent ILM Baseline Risk Assessment (G&M 1996).

SOURCES:

RAGS (EPA 1989a)
 Exposure Factors Handbook (EPA 1990b)

TABLE 4-2
DERMAL ABSORPTION VALUES

Constituent	ABS (unitless)	Constituent	ABS (unitless)
1-butanol	1.00E-01	4-methylphenol	1.00E-01
1,1-dichloroethane	1.00E-01	4,4-ddd	5.00E-02
1,1-dichloroethene	1.00E-01	4,4-dde	5.00E-02
1,1,1,2-tetrachloroethane	1.00E-01	4,4-ddt	5.00E-02
1,1,2-trichloroethane	1.00E-01	acenaphthene	1.50E-01
1,1,2,2-tetrachloroethane	1.00E-01	acetone	1.00E-01
1,2-dibromo-3-chloropropane	1.00E-01	acrolein	1.00E-01
1,2-dibromoethane	1.00E-01	acrylonitrile	1.00E-01
1,2-dichlorobenzene	1.00E-01	aldrin	5.00E-02
1,2-dichloroethane	1.00E-01	alpha-bhc	5.00E-02
1,2-dichloropropane	1.00E-01	aniline	1.00E-01
1,2-diphenylhydrazine	1.00E-01	anthracene	1.50E-01
1,2,3-trichloropropane	1.00E-01	antimony	1.00E-02
1,2,4-trichlorobenzene	1.00E-01	aroclor 1016	1.00E-01
1,3-dichloropropene	1.00E-01	aroclor 1254	1.00E-01
1,4-dichlorobenzene	1.00E-01	arsenic	3.00E-02
2-butanone	1.00E-01	barium	1.00E-02
2-chlorophenol	1.00E-01	benzene	1.00E-01
2-methylphenol	1.00E-01	benzidine	1.00E-01
2-naphthylamine	1.00E-01	benzoic acid	1.00E-01
2,4-dichlorophenol	1.00E-01	benzo(a)anthracene	1.50E-01
2,4-dimethylphenol	1.00E-01	benzo(a)pyrene	1.50E-01
2,4-dinitrophenol	1.00E-01	benzo(b)fluoranthene	1.50E-01
2,4-dinitrotoluene	1.00E-01	benzo(k)fluoranthene	1.50E-01
2,4,5-trichlorophenol	1.00E-01	benzyl alcohol	1.00E-01
2,4,6-trichlorophenol	1.00E-01	benzyl chloride	1.00E-01
2,6-dinitrotoluene	1.00E-01	beryllium	1.00E-02
3,3-dichlorobenzidine	1.00E-01	beta-bhc	5.00E-02
4-chloroaniline	1.00E-01	beta-chloronaphthalene	1.00E-01
4-methyl-2-pentanone	1.00E-01	bis(2-chloro-1-methylethyl)ether	1.00E-01

TABLE 4-2 (CONT.)

Constituent	ABS (unitless)	Constituent	ABS (unitless)
bis(2-chloroethyl)ether	1.00E-01	fluorene	1.00E-01
bis(2-ethylhexyl)phthalate	1.00E-01	gamma-bhc	5.00E-02
bromodichloromethane	1.00E-01	heptachlor	5.00E-02
bromoform	1.00E-01	heptachlor epoxide	5.00E-02
bromomethane	1.00E-01	hexachlorobenzene	1.00E-01
cadmium	1.00E-03	hexachlorobutadiene	1.00E-01
carbazole	1.00E-01	hexachlorocyclopentadiene	1.00E-01
carbon disulfide	1.00E-01	hexachloroethane	1.00E-01
carbon tetrachloride	1.00E-01	indeno(1,2,3-cd)pyrene	1.00E-01
chlordan	1.00E-01	isobutyl alcohol	1.00E-01
chlorobenzene	1.00E-01	isophorone	1.00E-01
chloroform	1.00E-01	mercury	1.00E-02
chloromethane	1.00E-01	methoxychlor	1.00E-01
chromium iii	1.00E-02	methyl methacrylate	1.00E-01
chromium vi	1.00E-04	methylene bromide	1.00E-01
chrysene	1.50E-01	methylene chloride	1.00E-01
cis-1,2-dichloroethene	1.00E-01	methyl-tert-butyl ether	1.00E-01
copper	1.00E-02	molybdenum	1.00E-02
cumene	1.00E-01	n-butylbenzyl phthalate	1.00E-01
cyanide	1.00E-02	nickel	1.00E-02
dibenzo(a,h)anthracene	1.50E-01	nitroaniline, o-	1.00E-01
dibromochloromethane	1.00E-01	nitrobenzene	1.00E-01
dichlorodifluoromethane	1.00E-01	nitrosodiphenylamine, p-	1.00E-01
dieldrin	5.00E-02	n-nitrosodimethylamine	1.00E-01
diethyl phthalate	1.00E-01	n-nitroso-di-n-propylamine	1.00E-01
di-n-butylphthalate	1.00E-01	n-nitrosodiphenylamine	1.00E-01
di-n-octylphthalate	1.00E-01	o-chlorotoluene	1.00E-01
endosulfan	5.00E-02	p-chloro-m-cresol	1.00E-01
endrin	5.00E-02	pentachlorophenol	2.50E-01
ethyl chloride	1.00E-01	phenol	1.00E-01
ethylbenzene	1.00E-01	pyrene	1.50E-01
fluoranthene	1.00E-01	selenium	1.00E-02

TABLE 4-2 (CONT.)

Constituent	ABS (unitless)	Constituent	ABS (unitless)
silver	1.00E-02	trichlorofluoromethane	1.00E-01
styrene	1.00E-01	vanadium	1.00E-02
tetrachloroethene	1.00E-01	vinyl acetate	1.00E-01
toluene	1.00E-01	vinyl chloride	1.00E-01
toxaphene	1.00E-01	xlenes	1.00E-01
trans-1,2-dichloroethene	1.00E-01	zinc	1.00E-02
trichloroethene	1.00E-01		

SOURCE:

RAGS (EPA 1989a)

Exposure Factors Handbook (EPA 1990b)

4.1 DIRECT EXPOSURE QUANTIFICATION

For direct exposure pathways, the point of exposure (POE) is located at the source zone; consequently, the constituent concentration at the POE is equal to the representative concentration determined for the source medium. Therefore, standard intake and risk quantification equations presented in RAGS (EPA 1989a) can be used to evaluate these exposures. The direct exposure pathways presented in this section - the incidental ingestion of soil and dermal contact with soils - are associated with the construction scenario. No direct exposure pathways are quantified under the commercial/industrial scenario, since all direct exposures will be prevented through the construction of parking areas, buildings, and associated landscaping.

4.1.1 Incidental Ingestion of Soil

Equation 6-14 from RAGS (EPA 1989a) was used to quantify intake from the ingestion pathway:

$$I_{si} = (C_s)(IR)(CF)(FI)(EF)(ED) / (BW)(AT) \quad (4-1)$$

where

- I_{si} = intake from incidental ingestion of soil for a constituent (mg/kg-d)
- C_s = concentration of constituent in soil (mg/kg)
- IR = ingestion rate (mg/d)
- CF = conversion factor, 10^{-6} kg/mg
- FI = fraction ingested from constituent source (unitless)
- EF = exposure frequency (d/y)
- ED = exposure duration (y)
- BW = body weight (kg)
- AT = averaging time (d); for noncarcinogens, ED times 365 d/y;
for carcinogens, 70 y times 365 d/y

The construction worker and 1,1-dichloroethane have been selected for the example calculation. Specifically, intakes resulting from ingestion of soil containing a unit concentration of 1 mg/kg of 1,1-dichloroethane are calculated. This constituent was chosen because it potentially exhibits both carcinogenic and toxic effects. The reasonable maximum ingestion rate (IR) of soil for construction activities is 480 mg per day with a fractional intake (FI) of 1. The exposure frequency (EF) is 90 days per year, and the exposure duration (ED) is 1 year. The body weight (BW) for an adult is 70 kilograms. Since 1,1-dichloroethane potentially exhibits both potential carcinogenic and toxic effects, receptor intakes must be evaluated for both adverse effects. For potential carcinogenic effects, the intake is averaged over a 70-year lifetime (AT = 25,550 d). For

potential toxic hazards, the intake is averaged over the actual duration of exposure (AT = ED x 365 d). For the construction worker, the exposure duration is less than 1 year and averaged over 126 days (G&M 1996). Table 4-1 presents the exposure parameters and sources used in this report. Substituting these values into Equation 4-1 yields:

Carcinogens (4-2)

$$I_{si} = (1 \text{ mg/kg})(480 \text{ mg/d}) (10^{-6})(1)(90 \text{ d/y})(1 \text{ y}) / (70 \text{ kg})(25550 \text{ d})$$

$$I_{si} = 2.42 \times 10^{-8} \text{ mg/kg-d}$$

Noncarcinogens

$$I_{si} = (1 \text{ mg/kg})(480 \text{ mg/d}) (10^{-6})(1)(90 \text{ d/y})(1 \text{ y}) / (70 \text{ kg})(126 \text{ d})$$

$$I_{si} = 4.90 \times 10^{-6} \text{ mg/kg-d}$$

The calculation of constituent intake by a receptor responds linearly to changes in constituent concentration in soils. The unit risk and unit hazard to this receptor through this pathway from this constituent are calculated as follows:

$$UR_{si} = I_{si} \times SF_{ing} \quad (4-3)$$

$$UH_{si} = I_{si} / RfD_{ing}$$

where

- UR_{si} = unit risk to receptor from incidental ingestion of soil
- UH_{si} = unit hazard to receptor from incidental ingestion of soil
- SF_{ing} = slope factor for ingestion of a constituent $[(\text{mg/kg-d})^{-1}]$
- RfD_{ing} = reference dose for ingestion of a constituent (mg/kg-d)
- I_{si} = intake from incidental ingestion of soil containing 1 mg/m³ of a constituent (mg/kg-d)

The relationship between soil concentration and risk for this receptor, pathway, and constituent is determined by substituting the 1,1-dichloroethane intake (calculated in Equation 4-1), ingestion slope factor, and reference dose into Equation 4-3. Toxicity values used for these calculations are presented in Section 2 of this report. Substituting the appropriate values yields:

$$UR_{si} = (2.42 \times 10^{-8} \text{ mg/kg-d})(5.70 \times 10^3 \text{ kg-d/mg}) \quad (4-4)$$

$$UH_{si} = (4.90 \times 10^{-6} \text{ mg/kg-d}) / (1.00 \times 10^{-9} \text{ mg/kg-d})$$

or

$$UR_{si} = 1.38 \times 10^{-10}$$

$$UH_{si} = 4.90 \times 10^6$$

Because a unit concentration of 1.0 mg/kg was used in the example soil intake equation, and the intake responds linearly to changes in concentration, 1.38×10^{-10} and 4.90×10^{-6} represent unit risk and unit hazard factors. That is, each additional milligram per kilogram of 1,1-dichloroethane in the soil increases carcinogenic risk by 1.38×10^{-10} and toxic hazard by 4.90×10^{-6} for the construction worker. Appendix A presents the complete calculation sheets for soil ingestion unit risk values.

4.1.2 Dermal Contact with Soil

Equation 6-15 from the RAGS (EPA 1989a) was used to quantify intake from the dermal contact pathway:

$$I_{sd} = (C_s)(SA)(CF)(AF)(ABS)(EF)(ED) / (BW)(AT) \quad (4-5)$$

where

I_{sd}	=	intake from dermal contact with soil or sediment for a constituent (mg/kg-d)
C_s	=	concentration of a constituent in soil or sediment (mg/kg)
SA	=	skin surface area in contact with soils (cm^2/d)
CF	=	conversion factor, 10^{-6} kg/mg
AF	=	soil to skin adherence factor (mg/cm^2)
ABS	=	constituent-specific absorption factor (unitless), from Table 4-2
EF	=	exposure frequency (d/y)
ED	=	exposure duration (y)
BW	=	body weight (kg)
AT	=	averaging time (d); for noncarcinogens, ED times 365 d/y; for carcinogens, 70 y times 365 d/y

The construction worker and 1,1-dichloroethane have been selected for the example calculation. Specifically, intakes resulting from dermal contact with soil containing a unit concentration of 1 mg/kg of 1,1-dichloroethane are calculated. This constituent was chosen because it potentially exhibits both carcinogenic and toxic effects. The adult skin surface area (SA) assumed exposed during construction activities is 5,800 cm^2 per day with a soil-to-skin adherence factor (AF) of 1.0 and an absorption factor (ABS) of 1.0×10^{-1} (Table 4-2 presents the absorption factors for each constituent evaluated in this report). The exposure frequency (EF) is 90 days per year, and the exposure duration (ED) is 1 year (construction schedule). The body weight for an adult is 70 kilograms. Since 1,1-dichloroethane potentially exhibits both carcinogenic and toxic effects, receptor intakes must be evaluated for both adverse effects. For potential carcinogenic effects, the intake is averaged over a 70-year lifetime (AT = 25,550 d). For potential toxic effects, the intake is averaged over the actual duration of exposure (AT = ED x 365 d). For the construction

worker, the exposure duration is less than 1 year and averaged over 126 days (G&M 1996). Substituting these values into Equation 4-5 yields:

Carcinogens (4-6)

$$I_{sd} = (1 \text{ mg/kg})(5800 \text{ cm}^2/\text{d})(10^{-6})(1 \text{ mg/cm}^2)(1 \times 10^{-1})(90 \text{ d/y})(1 \text{ y})/(70 \text{ kg})(25550 \text{ d}) \\ I_{sd} = 2.92 \times 10^{-8} \text{ mg/kg-d}$$

Noncarcinogens

$$I_{sd} = (1 \text{ mg/kg})(5800 \text{ cm}^2/\text{d})(10^{-6})(1 \text{ mg/cm}^2)(1 \times 10^{-1})(90 \text{ d/y})(1 \text{ y})/(70 \text{ kg})(126 \text{ d}) \\ I_{sd} = 5.92 \times 10^{-6} \text{ mg/kg-d}$$

The calculation of constituent intake by a receptor responds linearly to changes in constituent concentration in soil. The unit risk and unit hazard to this receptor through this pathway from this constituent are calculated as follows:

$$UR_{sd} = I_{sd} \times SF_{der} \quad (4-7) \\ UH_{sd} = I_{sd} / RfD_{der}$$

where

- UR_{sd} = unit risk to receptor from dermal contact with soil
- UH_{sd} = unit hazard to receptor from dermal contact with soil
- SF_{der} = slope factor for dermal contact with a constituent $[(\text{mg/kg-d})^{-1}]$
- RfD_{der} = reference dose for dermal contact with a constituent (mg/kg-d)
- I_{sd} = intake from dermal contact with soil containing 1 mg/m³ of a constituent (mg/kg-d)

The relationship between soil concentration and risk for this receptor, pathway, and constituent is determined by substituting the 1,1-dichloroethane intake (calculated in Equation 4-5), ingestion slope factor, and reference dose into Equation 4-7. Toxicity values used for these calculations are presented in Section 2 of this report. Substituting the appropriate values yields:

$$UR_{sd} = (2.92 \times 10^{-8} \text{ mg/kg-d})(6.33 \times 10^{-3} \text{ kg-d/mg}) \quad (4-8) \\ UH_{sd} = (5.92 \times 10^{-6} \text{ mg/kg-d}) / (9.00 \times 10^{-1} \text{ mg/kg-d})$$

or

$$UR_{sd} = 1.85 \times 10^{-10} \\ UH_{sd} = 6.58 \times 10^{-6}$$

Because a unit concentration of 1.0 mg/kg was used in the example dermal intake equation, and the intake responds linearly to changes in concentration, 1.85×10^{-10} and 6.58×10^{-6} represent unit risk and unit hazard factors. That is, each additional milligram per kilogram of 1,1-dichloroethane increases carcinogenic risk by 1.85×10^{-10} and toxic hazard by 6.58×10^{-6} for the construction worker. Appendix B presents the complete calculation sheets for soil ingestion unit risk values.

4.2 INDIRECT EXPOSURE QUANTIFICATION

The inhalation exposures for both the construction and commercial/industrial scenarios are characterized as indirect, meaning exposures occur away from or in a different medium from the source. The constituent concentrations at the POE are typically lower than the representative value determined for the source medium. To quantify exposure through these indirect pathways, the reduction in constituent concentrations associated with each transport mechanism from the source medium to the POE must be characterized in terms of an attenuation factor.

4.2.1 Development of Attenuation Factors

Attenuation factors for the volatilization and particulate resuspension of constituents have been developed for use in the quantification of potential construction worker inhalation exposures. The commercial/industrial scenario also requires the development of an attenuation factor for the quantification of potential future indoor air inhalation exposures. The following sections present the methodology used in the development of these attenuation factors for each of the transport mechanisms.

4.2.1.1 Volatilization Attenuation Factors

A volatilization emission model was used to calculate ambient air attenuation factors for constituents that volatilize from soil. This is the same model used by EPA to develop Preliminary Remediation Goals. The model consists of estimating the concentration of the constituent emitted from the soils and dispersed throughout ambient air during the transport from the source to the POE. Estimating a volatilization attenuation factor for airborne concentrations of constituents in the volatilized phase involves modeling both emissions and dispersion. The emission component follows the mathematical model developed by Farmer et al. (EPA 1980). The dispersion component is the AREA-ST model, an updated version of the Industrial Source Complex Model 2 (ISC2) developed by the EPA Office of Air Quality Planning and Standards.

The emission component incorporates several assumptions (EPA 1986). This equation, based on Frick's First Law of steady state diffusion, assumes that diffusion into the atmosphere occurs at a plane surface where concentrations remain constant. It ignores biodegradation, transport in water, adsorption, and production of landfill gas. Thus, diffusion of vapor through soil cover is the controlling factor. This emission component was proposed as a method to calculate concentrations of constituents in landfills without internal gas generation (EPA 1986).

The AREA-ST dispersion model is based on the Gaussian dispersion principle. Gaussian models assume that material which is continually released will be transported in a direction opposite to the wind direction, and time-averaged spreading of the pollutants will result in normal distribution if sampled in cross-sections of the plume.

AREA-ST is extremely useful as a practical modeling tool, but it relies on several fundamental assumptions that must be noted. Emission rates are assumed to be constant and continuous. No variations occur in wind speed, wind direction, or Pasquill stability class during transport from source to receptor.

The volatilization attenuation factor is calculated as follows:

$$VF = Q/C \times [(3.1416 \times Z \times T)^{1/2} / (2 \times De_i \times Pa \times Kas)] \times UC1 \quad (4-9)$$

where

VF	=	volatilization attenuation factor (m^3/kg)
Q/C	=	dispersion component, emission flux per unit concentration [($g/m^2/sec$)/(kg/m^3)]
Z	=	intermediate conversion factor (cm^2/sec)
T	=	exposure interval, 7.9×10^8 seconds (G&M 1996)
De _i	=	effective diffusivity of a constituent through a soil matrix (cm^2/sec)
Pa	=	air filled porosity of the soil matrix, 0.07 (unitless) (G&M 1996)
Kas	=	soil-to-air partition coefficient ($g soil/cm^3 air$)
UC1	=	unit conversion factor ($0.0001 m^2/cm^2$)

The dispersion coefficient, Q/C, is calculated using the following equation:

$$Q/C = \{exp[((0.1004 \times ln(A))-5.3466) + (2.92 \times sY)]\}^{-1} \quad (4-10)$$

where

A = assumed area of contiguous contamination, $484 m^2$ (Cal/EPA 1994)

sY = intermediate value for calculating Q/C derived as follows:

$$0.02685 \times \{0.25 + [(\ln(A) - 11.0509)^2 / 26.3608]\}$$

The effective diffusivity of the constituent through the soil matrix, De_i , is estimated by:

$$De_i = D_i x (Pa^{3.33} / Pt^2) \quad (4-11)$$

where

De_i = constituent-specific diffusivity of constituent in air (cm^2/sec), from Table 4-3
 Pa = air filled porosity of soil matrix, 0.07 (unitless) (G&M 1996)
 Pt = total porosity of soil matrix, 0.4 (unitless) (G&M 1996)

The soil-to-air partition coefficient, Kas , is derived from the constituent-specific soil-water partition coefficient and Henry's Law constant:

$$Kas = H / (R \times T \times Kd) \quad (4-12)$$

where

Kas = soil-to-air partition coefficient ($\text{g soil/cm}^3 \text{ air}$)
 H = constituent-specific Henry's Law Constant ($\text{atm-m}^3/\text{mol}$), from Table 4-3
 R = ideal gas constant, $8.206 \times 10^{-5} \text{ atm-m}^3/\text{mol/K}$
 T = temperature in Kelvin, 298 K (G&M 1996)
 Kd = soil-to-water partitioning coefficient (cm^3/g)

The intermediate conversion factor, Z , in the volatilization attenuation factor can be calculated using Equation 4-13:

$$Z = (De_i \times Pa) / [Pa + (ps \times (1-Pa) / Kas)] \quad (4-13)$$

where

De_i = effective diffusivity of a constituent through a soil matrix (cm^2/sec)
 Pa = air filled porosity of the soil matrix, 0.07 (unitless) (G&M 1996)
 ps = true soil or particle density, 2.72 g/cm^3 (G&M 1996)
 Kas = soil-to-air partition coefficient ($\text{g soil/cm}^3 \text{ air}$)

A summary of the calculated volatilization attenuation factors is presented in Table 4-4.

TABLE 4-3
CONSTITUENT-SPECIFIC CONSTANTS

Constituent	Henry's Law Constant, H' (atm-m ³ /mol)	Henry's Law Constant, H (unitless)	Organic Partitioning Coefficient, K _{oc} (cm ³ /g)	Diffusivity Coefficient, D _e (cm ² /s)
1-butanol	2.50E-02	1.02E+00	7.16E+01	6.94E-02
1,1-dichloroethane	5.87E-03	2.40E-01	3.00E+01	9.59E-02
1,1-dichloroethene	1.50E-02	6.13E-01	6.50E+01	1.01E-01
1,1,1,2-tetrachloroethane	2.76E-03	1.13E-01	6.61E+02	7.53E-02
1,1,2-trichloroethane	9.09E-04	3.72E-02	5.60E+01	7.97E-02
1,1,2,2-tetrachloroethane	4.70E-04	1.92E-02	1.18E+02	7.29E-02
1,2-dibromo-3-chloropropane	3.11E-04	1.27E-02	9.80E+01	7.08E-02
1,2-dibromoethane	1.31E-03	5.36E-02	4.40E+01	8.56E-02
1,2-dichlorobenzene	2.40E-03	9.81E-02	9.40E+02	7.11E-02
1,2-dichloroethane	1.10E-03	4.50E-02	1.65E+01	9.45E-02
1,2-dichloropropane	1.54E-01	6.30E+00	5.10E+01	8.50E-02
1,2-diphenylhydrazine	3.43E-09	1.40E-07	4.18E+02	6.96E-02
1,2,3-trichloropropane	3.44E-04	1.41E-02	6.31E+01	7.53E-02
1,2,4-trichlorobenzene	1.42E-03	5.81E-02	9.20E+03	6.54E-02
1,3-dichloropropene	1.77E-03	7.24E-02	4.80E+01	8.73E-02
1,4-dichlorobenzene	1.60E-03	6.54E-02	1.70E+03	7.13E-02
2-butanone	5.14E-05	2.10E-03	4.51E+00	8.94E-02
2-chlorophenol	3.49E-05	1.43E-03	7.30E+01	7.50E-02
2-methylphenol	1.10E-06	4.50E-05	1.50E+01	7.53E-02
2-naphthylamine	8.52E-08	3.48E-06	1.31E+02	6.14E-02
2,4-dichlorophenol	6.29E-06	2.57E-04	3.80E+02	6.83E-02
2,4-dimethylphenol	5.31E-07	2.17E-05	9.60E+01	6.94E-02
2,4-dinitrophenol	6.45E-10	2.64E-08	1.66E+01	6.04E-02
2,4-dinitrotoluene	1.86E-07	7.61E-06	2.51E+02	6.70E-02
2,4,5-trichlorophenol	6.00E-06	2.45E-04	9.99E+01	6.31E-02
2,4,6-trichlorophenol	4.82E-06	1.97E-04	2.00E+03	6.31E-02
2,6-dinitrotoluene	4.86E-07	1.99E-05	7.76E+01	6.11E-02
3,3-dichlorobenzidine	3.97E-09	1.62E-07	1.55E+03	5.07E-02
4-chloroaniline	3.00E-06	1.23E-04	4.17E+01	7.17E-02
4-methyl-2-pentanone	6.77E-05	2.77E-03	1.90E+01	7.87E-02

TABLE 4-3 (CONT.)

Constituent	Henry's Law Constant, H' (atm·m ³ /mol)	Henry's Law Constant, H (unitless)	Organic Partitioning Coefficient, K _{oc} (cm ³ /g)	Diffusivity Coefficient, D _e (cm ² /s)
4-methylphenol	2.37E-07	9.69E-06	1.70E+01	7.50E-02
4,4-ddd	7.96E-06	3.26E-04	7.70E+05	4.74E-02
4,4-dde	6.80E-05	2.78E-03	2.97E+04	5.34E-02
4,4-ddt	8.30E-06	3.39E-04	2.43E+05	4.47E-02
acenaphthene	2.40E-04	9.81E-03	4.60E+03	5.95E-02
acetone	3.67E-05	1.50E-03	2.20E+00	1.15E-01
acrolein	1.36E-04	5.56E-03	2.40E+01	1.05E-01
acrylonitrile	1.38E-04	5.64E-03	9.00E+00	1.00E-01
aldrin	4.96E-04	2.03E-02	9.60E+04	4.74E-02
alpha-bhc	5.87E-06	2.40E-04	3.80E+03	5.20E-02
aniline	1.08E-06	4.42E-05	3.50E+02	7.61E-02
anthracene	6.51E-05	2.66E-03	2.10E+04	5.90E-02
antimony	NV	NV	NV	NV
aroclor 1016	7.60E-04	3.11E-02	5.00E+04	5.25E-02
aroclor 1254	2.30E-03	9.41E-02	4.10E+05	5.25E-02
arsenic	NV	NV	NV	NV
barium	NV	NV	NV	NV
benzene	5.48E-03	2.24E-01	7.45E+01	9.32E-02
benzidine	3.03E-07	1.24E-05	1.05E+01	5.26E-02
benzoic acid	3.92E-07	1.60E-05	5.44E+01	7.07E-02
benzo(a)anthracene	8.00E-06	3.27E-04	1.40E+06	4.65E-02
benzo(a)pyrene	3.72E-05	1.52E-03	5.50E+06	4.65E-02
benzo(b)fluoranthene	1.18E-05	4.83E-04	5.50E+05	4.39E-02
benzo(k)fluoranthene	3.94E-05	1.61E-03	5.50E+05	4.39E-02
benzyl alcohol	5.57E-07	2.28E-05	6.31E+00	7.49E-02
benzyl chloride	3.17E-04	1.30E-02	1.39E+02	7.52E-02
beryllium	NV	NV	NV	NV
beta-bhc	4.47E-07	1.83E-05	3.80E+03	5.58E-02
beta-chloronaphthalene	2.12E-03	8.67E-02	4.80E+03	6.56E-02
bis(2-chloro-1-methylethyl)ether	1.10E-04	4.50E-03	6.10E+01	6.34E-02
bis(2-chloroethyl)ether	1.31E-05	5.36E-04	1.39E+01	7.21E-02

TABLE 4-3 (CONT.)

Constituent	Henry's Law Constant, H' (atm-m ³ /mol)	Henry's Law Constant, H (unitless)	Organic Partitioning Coefficient, K _{oc} (cm ³ /g)	Diffusivity Coefficient, D _e (cm ² /s)
bis(2-ethylhexyl)phthalate	1.10E-05	4.50E-04	1.00E+05	3.54E-02
bromodichloromethane	2.12E-04	8.67E-03	6.20E+01	8.97E-02
bromoform	5.60E-04	2.29E-02	1.98E+02	8.31E-02
bromomethane	6.40E-03	2.62E-01	7.60E+00	1.24E-01
cadmium	NV	NV	NV	NV
carbazole	8.65E-08	3.54E-06	6.37E+02	6.49E-02
carbon disulfide	1.23E-02	5.03E-01	5.40E+01	1.05E-01
carbon tetrachloride	2.40E-02	9.81E-01	3.30E+02	7.97E-02
chlordan	8.60E-04	3.52E-02	7.08E+04	5.20E-02
chlorobenzene	4.45E-03	1.82E-01	1.89E+02	7.19E-02
chloroform	3.20E-03	1.31E-01	4.40E+01	8.87E-02
chloromethane	9.90E-03	4.05E-01	5.50E+00	1.40E-01
chromium iii	NV	NV	NV	NV
chromium vi	NV	NV	NV	NV
chrysene	3.15E-07	1.29E-05	2.40E+05	4.53E-02
cis-1,2-dichloroethene	6.60E-03	2.70E-01	5.90E+01	9.98E-02
copper	NV	NV	NV	NV
cumene	1.50E-02	6.13E-01	2.70E+03	6.77E-02
cyanide	NV	NV	NV	NV
dibenzo(a,h)anthracene	2.61E-09	1.07E-07	3.30E+06	5.71E-02
dibromochloromethane	7.83E-03	3.20E-01	8.30E+01	8.61E-02
dichlorodifluoromethane	4.20E-01	1.72E+01	5.80E+01	9.44E-02
dieldrin	1.10E-05	4.50E-04	1.70E+03	4.88E-02
diethyl phthalate	1.50E-06	6.13E-05	6.90E+01	5.12E-02
di-n-butylphthalate	6.30E-05	2.58E-03	1.38E+03	4.38E-02
di-n-octylphthalate	5.50E-06	2.25E-04	1.90E+04	3.22E-02
endosulfan	1.01E-05	4.13E-04	2.03E+03	4.72E-02
endrin	4.20E-06	1.72E-04	1.06E+04	4.64E-02
ethyl chloride	2.00E-03	8.18E-02	1.50E+01	1.15E-01
ethylbenzene	8.68E-03	3.55E-01	1.77E+02	6.67E-02
fluoranthene	9.41E-06	3.85E-04	4.20E+04	4.94E-02

TABLE 4-3 (CONT.)

Constituent	Henry's Law Constant, H' (atm-m ³ /mol)	Henry's Law Constant, H (unitless)	Organic Partitioning Coefficient, Koc (cm ³ /g)	Diffusivity Coefficient, De (cm ² /s)
fluorene	2.10E-04	8.59E-03	5.00E+03	5.71E-02
gamma-bhc	7.85E-06	3.21E-04	1.08E+03	5.58E-02
heptachlor	1.48E-03	6.05E-02	6.00E+03	4.69E-02
heptachlor epoxide	3.20E-05	1.31E-03	2.20E+02	4.60E-02
hexachlorobenzene	1.70E-03	6.95E-02	3.90E+03	5.34E-02
hexachlorobutadiene	1.03E-02	4.21E-01	2.90E+04	5.94E-02
hexachlorocyclopentadiene	1.64E-02	6.71E-01	3.60E+03	3.76E-02
hexachloroethane	3.89E-03	1.59E-01	2.00E+04	6.48E-02
indeno(1,2,3-cd)pyrene	6.85E-08	2.80E-06	1.60E+06	5.73E-02
isobutyl alcohol	9.79E-06	4.00E-04	7.60E-01	7.65E-02
isophorone	5.76E-06	2.36E-04	8.70E+01	6.38E-02
mercury	NV	NV	NV	NV
methoxychlor	1.60E-05	6.54E-04	2.54E+04	4.48E-02
methyl methacrylate	1.05E-02	4.29E-01	8.70E+01	9.99E-02
methylene bromide	8.88E-04	3.63E-02	2.50E+01	8.58E-02
methylene chloride	2.69E-03	1.10E-01	8.70E+00	8.58E-02
methyl-tert-butyl ether	5.87E-04	2.40E-02	1.12E+01	9.88E-02
molybdenum	NV	NV	NV	NV
n-butylbenzyl phthalate	1.30E-06	5.32E-05	2.08E+02	4.11E-02
nickel	NV	NV	NV	NV
nitroaniline, o-	1.09E-07	4.46E-06	3.80E+01	6.83E-02
nitrobenzene	1.31E-05	5.36E-04	3.60E+01	7.40E-02
nitrosodiphenylamine, p-	5.00E-06	2.04E-04	6.48E+02	6.71E-02
n-nitrosodimethylamine	1.43E-01	5.85E+00	2.60E+01	9.69E-02
n-nitroso-di-n-propylamine	6.92E-06	2.83E-04	1.50E+01	8.14E-02
n-nitrosodiphenylamine	2.33E-08	9.53E-07	5.75E+02	6.71E-02
o-chlorotoluene	5.7E-03	2.33E-01	2.55E+02	7.11E-02
p-chloro-m-cresol	6.0E-07	2.45E-05	5.00E+01	9.00E-02
pentachlorophenol	3.40E-06	1.39E-04	8.91E+02	5.53E-02
phenol	3.95E-07	1.62E-05	2.20E+01	8.92E-02
pyrene	1.10E-05	4.50E-04	9.05E+04	5.04E-02

TABLE 4-3 (CONT.)

Constituent	Henry's Law Constant, H' (atm-m ³ /mol)	Henry's Law Constant, H (unitless)	Organic Partitioning Coefficient, K _{oc} (cm ³ /g)	Diffusivity Coefficient, D _e (cm ² /s)
selenium	NV	NV	NV	NV
silver	NV	NV	NV	NV
styrene	4.00E-03	1.64E-01	8.91E+02	7.04E-02
tetrachloroethene	2.87E-03	1.17E-01	2.86E+02	7.40E-02
toluene	6.74E-03	2.76E-01	1.33E+02	7.83E-02
toxaphene	4.98E-03	2.04E-01	2.10E+05	4.50E-02
trans-1,2-dichloroethene	6.74E-03	2.76E-01	5.90E+01	9.98E-02
trichloroethene	9.90E-03	4.05E-01	9.50E+01	8.12E-02
trichlorofluoromethane	5.83E-02	2.38E+00	1.59E+02	9.34E-02
vanadium	NV	NV	NV	NV
vinyl acetate	3.76E-04	1.54E-02	1.70E+01	9.36E-02
vinyl chloride	5.60E-02	2.29E+00	2.50E+00	1.07E-01
xylenes	6.30E-03	2.58E-01	8.54E+02	8.70E-02
zinc	NV	NV	NV	NV

NOTES:

NV - Not Volatile

SOURCES:

Foreman and Bidleman, 1985; Howard et al., 1991; Howard, 1991, 1990, and 1989; Lugg, 1968; Lyan et al., 1990; Mackay and Shiu, 1981; Montgomery and Welkom, 1990; Shen, 1982, and Verschueren, 1983.

TABLE 4-4
CALCULATED CONSTITUENT-SPECIFIC
VOLATILIZATION ATTENUATION FACTORS

Constituent	VF (m ³ /kg)	Constituent	VF (m ³ /kg)
1-butanol	3.92E+04	4-methylphenol	6.25E+06
1,1-dichloroethane	4.54E+04	4,4-ddd	2.89E+08
1,1-dichloroethene	4.06E+04	4,4-dde	1.83E+07
1,1,1,2-tetrachloroethane	3.60E+05	4,4-ddt	1.64E+08
1,1,2-trichloroethane	1.77E+05	acenaphthene	3.63E+06
1,1,2,2-tetrachloroethane	3.75E+05	acetone	1.46E+05
1,2-dibromo-3-chloropropane	4.27E+05	acrolein	2.62E+05
1,2-dibromoethane	1.26E+05	acrylonitrile	1.63E+05
1,2-dichlorobenzene	4.74E+05	aldrin	1.29E+07
1,2-dichloroethane	7.98E+04	alpha-bhc	2.26E+07
1,2-dichloropropane	9.27E+03	aniline	1.32E+07
1,2-diphenylhydrazine	2.67E+08	anthracene	1.49E+07
1,2,3-trichloropropane	3.15E+05	antimony	NA
1,2,4-trichlorobenzene	2.01E+06	aroclor 1016	7.16E+06
1,3-dichloropropene	1.12E+05	aroclor 1254	1.18E+07
1,4-dichlorobenzene	7.80E+05	arsenic	NA
2-butanone	2.00E+05	barium	NA
2-chlorophenol	1.07E+06	benzene	7.64E+04
2-methylphenol	2.72E+06	benzidine	5.19E+06
2-naphthylamine	3.20E+07	benzoic acid	8.96E+06
2,4-dichlorophenol	6.01E+06	benzo(a)anthracene	3.92E+08
2,4-dimethylphenol	1.03E+07	benzo(a)pyrene	3.60E+08
2,4-dinitrophenol	1.32E+08	benzo(b)fluoranthene	2.08E+08
2,4-dinitrotoluene	2.87E+07	benzo(k)fluoranthene	1.14E+08
2,4,5-trichlorophenol	3.29E+06	benzyl alcohol	2.49E+06
2,4,6-trichlorophenol	1.64E+07	benzyl chloride	4.88E+05
2,6-dinitrotoluene	1.03E+07	beryllium	NA
3,3-dichlorobenzidine	5.61E+08	beta-bhc	7.89E+07
4-chloroaniline	2.81E+06	beta-chloronaphthalene	1.19E+06
4-methyl-2-pentanone	3.82E+05	bis(2-chloro-1-methylethyl)ether	5.98E+05

TABLE 4-4 (CONT.)

Constituent	VF (m ³ /kg)	Constituent	VF (m ³ /kg)
bis(2-chloroethyl)ether	7.75E+05	fluorene	4.13E+06
bis(2-ethylhexyl)phthalate	1.02E+08	gamma-bhc	1.00E+07
bromodichloromethane	3.65E+05	heptachlor	1.88E+06
bromoform	4.17E+05	heptachlor epoxide	2.47E+06
bromomethane	1.78E+04	hexachlorobenzene	1.33E+06
cadmium	NA	hexachlorobutadiene	1.39E+06
carbazole	6.81E+07	hexachlorocyclopentadiene	4.88E+05
carbon disulfide	4.02E+04	hexachloroethane	1.80E+06
carbon tetrachloride	8.31E+04	indeno(1,2,3-cd)pyrene	4.08E+09
chlordan	8.04E+06	isobutyl alcohol	2.03E+05
chlorobenzene	1.55E+05	isophorone	3.11E+06
chloroform	7.88E+04	mercury	NA
chloromethane	1.04E+04	methoxychlor	3.80E+07
chromium iii	NA	methyl methacrylate	5.73E+04
chromium vi	NA	methylene bromide	1.15E+05
chrysene	8.29E+08	methylene chloride	3.76E+04
cis-1,2-dichloroethene	5.96E+04	methyl-tert-butyl ether	8.82E+04
copper	NA	molybdenum	NA
cumene	3.29E+05	n-butylbenzyl phthalate	1.26E+07
cyanide	NA	nickel	NA
dibenzo(a,h)anthracene	3.01E+10	nitroaniline, o-	1.44E+07
dibromochloromethane	7.00E+04	nitrobenzene	1.23E+06
dichlorodifluoromethane	4.43E+03	nitrosodiphenylamine, p-	8.89E+06
dieldrin	1.14E+07	n-nitrosodimethylamine	5.48E+03
diethyl phthalate	6.06E+06	n-nitroso-di-n-propylamine	1.04E+06
di-n-butylphthalate	4.52E+06	n-nitrosodiphenylamine	1.23E+08
di-n-octylphthalate	6.62E+07	o-chlorotoluene	1.60E+05
endosulfan	1.32E+07	p-chloro-m-cresol	6.15E+06
endrin	4.71E+07	pentachlorophenol	1.39E+07
ethyl chloride	5.08E+04	phenol	5.05E+06
ethylbenzene	1.11E+05	pyrene	8.17E+07
fluoranthene	6.08E+07	selenium	NA

TABLE 4-4 (CONT.)

Constituent	VF (m ³ /kg)	Constituent	VF (m ³ /kg)
silver	NA	trichlorofluoromethane	3.29E+04
styrene	3.60E+05	vanadium	NA
tetrachloroethene	2.34E+05	vinyl acetate	1.40E+05
toluene	1.01E+05	vinyl chloride	1.52E+03
toxaphene	6.19E+06	xylenes	2.52E+05
trans-1,2-dichloroethene	5.89E+04	zinc	NA
trichloroethene	6.85E+04		

NOTES:

NA = Not Available. No toxicity data exist for pathways.

4.2.1.2 Particulate Resuspension Attenuation Factors

Estimating airborne concentrations of constituents in the particulate phase involves modeling both resuspension and dispersion. The resuspension component was designed by Cowherd (1985) as a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides relatively continuous and constant potential for emission over an extended period of time. This component considers wind-borne emissions and does not consider dust emissions from traffic or other forms of mechanical disturbances. However, it is felt that the degree of accuracy attainable using this model is consistent with that generally expected to result from simplified quantitative estimation procedures (EPA 1986). This opinion is consistent with the findings of DTSC on the use of this model at the adjacent Lockheed Martin ILM facility.

The Gaussian dispersion component applied to volatile emissions (Section 4.2.1.1) is also applied to particulate dispersion.

The particulate resuspension attenuation factor is calculated as follows:

$$PEF = Q/C \times \{3600/[RPF \times (1-G) \times (Um/Ut)^3 \times Fx]\} \quad (4-14)$$

where

PEF	=	particulate attenuation factor (m^3/kg)
Q/C	=	dispersion component, emission flux per unit concentration [($g/m^2/sec$)/(kg/m^3)]
RPF	=	respirable fraction of particulate, 0.036 $g/m^2/h$ (G&M 1996)
Um	=	wind speed, 4.5 m/sec (G&M 1996)
Ut	=	equivalent threshold value of wind speed at 10 meters, 12.8 m/sec (G&M 1996)
Fx	=	Function describing Ut/Um (unitless), from Equation 4-15

Function Fx is calculated as follows:

$$Fx = 0.18 \times [8X^3 + 12X] \times \exp[-(X^2)] \quad (4-15)$$

where

$$X = 0.886 \times (Ut/Um)$$

The dispersion coefficient, Q/C, is calculated using the following equation:

$$Q/C = \{\exp[((0.1004 \times \ln(A))-5.3466) + (2.92 \times sY)]\}^{-1} \quad (4-16)$$

where

$$\begin{aligned} A &= \text{assumed area of contiguous contamination, } 484 \text{ m}^2 (\text{Cal/EPA 1994}) \\ sY &= \text{intermediate value for calculating Q/C derived as follows:} \\ &\quad 0.02685 \times \{0.25 + [(\ln(A) - 11.0509)^2 / 26.3608]\} \end{aligned}$$

As shown in the previous equations, the calculated particulate attenuation factor is independent of the constituent and represents a constant rate of resuspension of soil. The calculated value used in this report is $4.77 \times 10^9 \text{ m}^3/\text{kg}$.

4.2.1.3 Indoor Air Attenuation Factors

A vapor intrusion model was used to calculate indoor air attenuation factors for constituents that volatilize from soil and enter a building. The model consists of estimating the constituent concentration in soil gas, the subsequent movement of the vapor phase constituent upward to the atmosphere, and then the concentrations of the constituent in indoor air. The calculation follows the mathematical model developed by Daugherty (1991).

The vapor intrusion model incorporates several assumptions (Daugherty 1991). The model considers only diffusive flux, not pressure or convection driven flow. The constituent is assumed to be present as a nondiminishing steady state source; however, for most constituents, biodegradation and other attenuation forces are expected to occur in subsurface soils over time. Therefore, this is a conservative assumption. The system is assumed to be at equilibrium, and exposure to constituents above equilibrium levels due to shutdown of the building ventilation system is assumed to be trivial in terms of exposure duration. It is assumed that flux occurs only through infiltration areas such as cracks in the building slab and that flux through the building slab itself is insignificant (Daugherty 1991).

The vapor intrusion model was proposed as a method to calculate constituent concentrations in indoor air based on specified constituent concentrations in soil gas (Daugherty 1991). Physical parameters such as moisture content, dry soil density, porosity, and effective air permeability affect the rate at which the vapors from a volatile constituent may migrate through the soils. Site-specific values for these soil parameters were obtained from the ILM Baseline Risk Assessment (G&M 1996). Conservative default values were identified based on known site characteristics for parameters that were not measured directly. Assumed parameters of the hypothetical building (e.g., building dimensions) were also used in the model. In cases where

site-specific values for model parameters were not readily available, conservative default values were identified based on known site conditions (e.g., moisture content of soil).

The constituent concentrations in soil pore water were estimated from the representative soil concentrations:

$$C_{pw} = Cs / (Koc \times foc) \quad (4-17)$$

where

- C_{pw} = concentration in soil pore water (mg/L)
 C_s = representative concentration in soil (mg/kg)
Foc = fraction of organic carbon, 0.004 (unitless) (G&M 1996)
Koc = organic carbon partition coefficient (L/kg), from Table 4-6

Detected concentrations of constituents at the site are relatively low; therefore, it was assumed that volatile constituents were dissolved in soil pore water. Thus, the concentrations in soil pore water and the Henry's Law Constant for the constituent were used to estimate the concentration of constituents in soil pore gas:

$$C_{sg} = C_{pw} \times Ho \times UC1 \quad (4-18)$$

where:

- C_{pw} = concentration in soil pore water (mg/L)
 C_{sg} = concentration in soil gas (mg/cm³)
Ho = Henry's Law Constant (unitless), from Table 4-3
UC1 = unit conversion, 0.001 L/cm³

Effective diffusivity, De, of the constituent through the soil was approximated as:

$$De = D_i \times (Pt - (M \times B))^{3.33} / Pt^2 \quad (4-19)$$

where

- B = bulk density of soil, 1.65 g/cm³ (G&M 1996)
De = effective diffusion coefficient (cm²/sec)
 D_i = constituent-specific diffusivity of constituent in air (cm²/sec), from Table 4-3
M = moisture content of soil, 0.2 cm³/g (G&M 1996)
Pt = total soil porosity, 0.4 (unitless) (G&M 1996)

The effective diffusion coefficient and soil gas concentration were used to calculate the diffusive flux of the constituent from subsurface soils to the atmosphere:

$$F = C_{sg} \times De / X \quad (4-20)$$

where

- F = flux ($\text{mg}/\text{cm}^2\text{-sec}$)
C_{sg} = concentration in soil gas (mg/cm^3)
De = effective diffusion coefficient (cm^2/sec)
X = effective depth of cover, 366 cm (from the site demolition and removal plan)

The attenuation factor was calculated by dividing the product of flux and area of infiltration by the product of building air exchange rate and building volume:

$$C_i = F \times A \times UC2 \times UC3 / (AER \times V) \quad (4-21)$$

where

- C_i = indoor air attenuation factor (mg/m^3 per mg/kg of constituent in soil)
A = area of infiltration, 186 m^2 (Cal/EPA 1994)
AER = building air exchange rate, 0.5 volumes/hour (G&M 1996)
F = flux ($\text{mg}/\text{cm}^2\text{-sec}$)
UC2 = unit conversion 10,000 cm^2/m^2
UC3 = unit conversion 3,600 sec/hr
V = volume of building, 454 m^3 (G&M 1996)

Because a unit concentration of 1.0 mg/kg of 1,1-dichloroethane in soils was used in the example attenuation development equation, and the vapor intrusion model responds linearly to changes in source concentration, 1.52×10^{-8} represents a unit attenuation factor. That is, each additional milligram per kilogram of 1,1-dichloroethane in soil increases indoor air concentrations by 1.52×10^{-8} .

The indoor air attenuation factors calculated using this vapor intrusion model are predicted values based on site-specific and constituent-specific factors. A summary of these factors is presented in Table 4-5.

TABLE 4-5
CONSTITUENT-SPECIFIC INDOOR AIR
ATTENUATION FACTOR

Constituent	C _i (m ³ /kg)	Constituent	C _i (m ³ /kg)
1-butanol	8.90E-06	4-methylphenol	3.84E-10
1,1-dichloroethane	6.89E-06	4,4-ddd	1.80E-13
1,1-dichloroethene	8.54E-06	4,4-dde	4.49E-11
1,1,1,2-tetrachloroethane	1.15E-07	4,4-ddt	5.60E-13
1,1,2-trichloroethane	4.75E-07	acenaphthene	1.14E-09
1,1,2,2-tetrachloroethane	1.07E-07	acetone	7.04E-07
1,2-dibromo-3-chloropropane	8.25E-08	acrolein	2.19E-07
1,2-dibromoethane	9.36E-07	acrylonitrile	5.63E-07
1,2-dichlorobenzene	6.67E-08	aldrin	9.00E-11
1,2-dichloroethane	2.31E-06	alpha-bhc	2.95E-11
1,2-dichloropropane	9.43E-05	aniline	8.62E-11
1,2-diphenylhydrazine	2.10E-13	anthracene	6.72E-11
1,2,3-trichloropropane	1.51E-07	antimony	NA
1,2,4-trichlorobenzene	3.71E-09	aroclor 1016	2.93E-10
1,3-dichloropropene	1.18E-06	aroclor 1254	1.08E-10
1,4-dichlorobenzene	2.47E-08	arsenic	NA
2-butanone	3.74E-07	barium	NA
2-chlorophenol	1.32E-08	benzene	2.52E-06
2-methylphenol	2.03E-09	benzidine	5.57E-10
2-naphthylamine	1.47E-11	benzoic acid	1.87E-10
2,4-dichlorophenol	4.15E-10	benzo(a)anthracene	9.77E-14
2,4-dimethylphenol	1.41E-10	benzo(a)pyrene	1.16E-13
2,4-dinitrophenol	8.62E-13	benzo(b)fluoranthene	3.46E-13
2,4-dinitrotoluene	1.82E-11	benzo(k)fluoranthene	1.16E-12
2,4,5-trichlorophenol	1.39E-09	benzyl alcohol	2.43E-09
2,4,6-trichlorophenol	5.58E-11	benzyl chloride	6.30E-08
2,6-dinitrotoluene	1.40E-10	beryllium	NA
3,3-dichlorobenzidine	4.77E-14	beta-bhc	2.41E-12
4-chloroaniline	1.90E-09	beta-chloronaphthalene	1.06E-08
4-methyl-2-pentanone	1.03E-07	bis(2-chloro-1-methylethyl)ether	4.20E-08

TABLE 4-5 (CONT.)

Constituent	C_i (m³/kg)	Constituent	C_i (m³/kg)
bis(2-chloroethyl)ether	2.50E-08	fluorene	8.81E-10
bis(2-ethylhexyl)phthalate	1.43E-12	gamma-bhc	1.49E-10
bromodichloromethane	1.13E-07	heptachlor	4.25E-09
bromoform	8.64E-08	heptachlor epoxide	2.46E-09
bromomethane	3.82E-05	hexachlorobenzene	8.55E-09
cadmium	NA	hexachlorobutadiene	7.75E-09
carbazole	3.24E-12	hexachlorocyclopentadiene	6.29E-08
carbon disulfide	8.74E-06	hexachloroethane	4.63E-09
carbon tetrachloride	2.13E-06	indeno(1,2,3-cd)pyrene	9.01E-16
chlordan	2.32E-10	isobutyl alcohol	3.62E-07
chlorobenzene	6.22E-07	isophorone	1.55E-09
chloroform	2.37E-06	mercury	NA
chloromethane	9.24E-05	methoxychlor	1.04E-11
chromium iii	NA	methyl methacrylate	4.43E-06
chromium vi	NA	methylene bromide	1.12E-06
chrysene	2.18E-14	methylene chloride	9.74E-06
cis-1,2-dichloroethene	4.10E-06	methyl-tert-butyl ether	1.90E-06
copper	NA	molybdenum	NA
cumene	1.38E-07	n-butylbenzyl phthalate	9.44E-11
cyanide	NA	nickel	NA
dibenzo(a,h)anthracene	1.66E-17	nitroaniline, o-	7.19E-11
dibromochloromethane	2.98E-06	nitrobenzene	9.89E-09
dichlorodifluoromethane	2.51E-04	nitrosodiphenylamine, p-	1.90E-10
dieldrin	1.16E-10	n-nitrosodimethylamine	1.96E-04
diethyl phthalate	4.09E-10	n-nitroso-di-n-propylamine	1.38E-08
di-n-butylphthalate	7.35E-10	n-nitrosodiphenylamine	9.99E-13
di-n-octylphthalate	3.43E-12	o-chlorotoluene	5.84E-07
endosulfan	8.62E-11	p-chloro-m-cresol	3.97E-10
endrin	6.76E-12	pentachlorophenol	7.75E-11
ethyl chloride	5.62E-06	phenol	5.88E-10
ethylbenzene	1.20E-06	pyrene	2.25E-12
fluoranthene	4.07E-12	selenium	NA

TABLE 4-5 (CONT.)

Constituent	C_i (m ³ /kg)	Constituent	C_i (m ³ /kg)
silver	NA	trichlorofluoromethane	1.26E-05
styrene	1.16E-07	vanadium	NA
tetrachloroethene	2.73E-07	vinyl acetate	7.61E-07
toluene	1.46E-06	vinyl chloride	8.82E-04
toxaphene	3.92E-10	xylenes	2.36E-07
trans-1,2-dichloroethene	4.19E-06	zinc	NA
trichloroethene	3.11E-06		

NOTES:

NA = Not Available. No toxicity data exist for pathways.

4.2.2 Quantification of Inhalation Pathways

After the attenuation factors were calculated (Section 4.2.1), Equation 6-16 from RAGS (EPA 1989a) was used to quantify intake from the inhalation pathway:

$$I_{inh} = (C_s)(ATFs)(IH)(ET)(EF)(ED) / (BW)(AT) \quad (4-22)$$

where

- I_{inh} = intake through inhalation of airborne constituents (mg/kg-d)
 C_s = concentration of a constituent in soil (mg/kg)
ATFs = receptor-specific attenuation factors;
for construction worker, $1/VF + 1/PEF$, VF from Tables 4-4;
for commercial/industrial user, C_i , from Table 4-5
IH = inhalation rate (m^3/h)
ET = exposure time (hr/d)
EF = exposure frequency (d/y)
ED = exposure duration (y)
BW = body weight (kg)
AT = averaging time (d); for noncarcinogens, ED times 365 d/y;
for carcinogens, 70 y times 365 d/y

The construction worker and 1,1-dichloroethane have been selected for the example calculation. Specifically, intakes resulting from inhalation of airborne 1,1-dichloroethane originating from soil containing a unit concentration of 1 mg/kg are calculated. This constituent was chosen because it potentially exhibits both carcinogenic and toxic effects.

The construction worker is anticipated to be exposed to both volatile and particulate emissions; therefore, both attenuation factors are used ($VF = 4.5 \times 10^4$ and $PEF = 4.8 \times 10^9$). The reasonable maximum inhalation rate (IH) during construction activities is $2.5 m^3$ per hour during an 8-hour day (ET). The exposure frequency (EF) is 90 days per year, and the exposure duration (ED) is 1 year. The body weight (BW) for an adult is 70 kilograms. Since 1,1-dichloroethane potentially exhibits both carcinogenic and toxic effects, receptor intakes must be evaluated for both adverse effects. For potential carcinogenic effects, receptor intake is averaged over a 70-year lifetime (AT = 25,550 d). For potential toxic hazards, the intake is averaged over the actual duration of exposure (AT = ED x 365 d). For the construction worker, the exposure duration is less than 1 year and averaged over 126 days (G&M 1996). Exposure parameters are presented in Table 4-1.

Substituting these values into Equation 4-23 yields:

Carcinogens (4-23)

$$I_{sinh} = (1 \text{ mg/kg})(1/4.54 \times 10^4 + 1/4.77 \times 10^9)(2.5 \text{ m}^3/\text{h})(8\text{h/d})(90 \text{ d/y})(1 \text{ y}) / (70 \text{ kg})(25550 \text{ d})$$

$$I_{sinh} = 2.22 \times 10^{-8} \text{ mg/kg-d}$$

Noncarcinogens

$$I_{sinh} = (1 \text{ mg/kg})(1/4.54 \times 10^4 + 1/4.77 \times 10^9)(2.5 \text{ m}^3/\text{h})(8\text{h/d})(90 \text{ d/y})(1 \text{ y}) / (70 \text{ kg})(126 \text{ d})$$

$$I_{sinh} = 4.50 \times 10^{-6} \text{ mg/kg-d}$$

The calculation of constituent intake by a receptor responds linearly to changes in constituent concentration in soils. The unit risk and unit hazard to this receptor through this pathway from this constituent are calculated as follows:

$$UR_{sinh} = I_{sinh} \times SF_{inh} \quad (4-24)$$

$$UH_{sinh} = I_{sinh} / RfD_{inh}$$

where

- UR_{sinh} = unit risk to receptor from inhalation of airborne constituents
- UH_{sinh} = unit hazard to receptor from inhalation of airborne constituents
- SF_{inh} = slope factor for inhalation of a constituent $[(\text{mg/kg-d})^{-1}]$
- RfD_{inh} = reference dose for inhalation of a constituent (mg/kg-d)
- I_{sinh} = intake from inhalation of airborne constituents originating from soil containing 1 mg/m^3 of constituent (mg/kg-d)

The relationship between soil concentration and risk for this receptor, pathway, and constituent is determined by substituting the 1,1-dichloroethane intake (calculated in Equation 4-23), inhalation slope factor, and reference dose into Equation 4-25. Toxicity values used for these calculations are presented in Section 2 of this report. Substituting the appropriate values yields:

$$UR_{sinh} = (2.22 \times 10^{-8} \text{ mg/kg-d})(5.70 \times 10^{-3} \text{ kg-d/mg}) \quad (4-25)$$

$$UH_{sinh} = (4.50 \times 10^{-6} \text{ mg/kg-d}) / (1.40 \times 10^0 \text{ mg/kg-d})$$

or

$$UR_{sinh} = 1.26 \times 10^{-10}$$

$$UH_{sinh} = 3.21 \times 10^{-6}$$

Because a unit concentration of 1.0 mg/kg was used in the example soil intake equation, and the intake responds linearly to changes in concentration, 1.26×10^{-10} and 3.21×10^{-6} represent unit risk and unit hazard factors. That is, each additional milligram per kilogram of 1,1-dichloroethane in the soil increases carcinogenic risk by 1.26×10^{-10} and toxic hazard by 3.21×10^{-6} for the construction worker. Appendix C presents the complete calculation sheets for inhalation unit risk values.

4.3 AGGREGATE RISK FOR ALL PATHWAYS

The aggregate risk from all exposure pathways must be calculated for each receptor identified in the CEM as having multiple complete exposure pathways. For example, the CEM (Section 3) indicates that the construction worker can be exposed to contaminated soil directly through incidental ingestion or dermal contact and indirectly through inhalation of constituents. The aggregate risk to the receptor as a result of soil exposure is calculated by summing the pathway-specific unit risk and unit hazard, as follows:

$$UR_s = UR_{si} + UR_{sd} + UR_{sinh} \quad (4-26)$$

$$UH_s = UH_{si} + UH_{sd} + UH_{sinh}$$

where

- UR_s = total unit risk from exposure to soil
- UR_{si} = unit risk from incidental soil ingestion
- UR_{sd} = unit risk from dermal contact
- UR_{sinh} = unit risk from inhalation
- UH_s = total unit hazard from exposure to soil
- UH_{si} = unit hazard from incidental soil ingestion
- UH_{sd} = unit hazard from dermal contact
- UH_{sinh} = unit hazard from inhalation

The intake by the construction worker for each milligram per kilogram of 1,1-dichloroethane in soil from each of these pathways is calculated in Sections 4.1 and 4.2. Substituting these values into Equation 4-27 yields:

$$UR_s = (1.38 \times 10^{-10}) + (1.85 \times 10^{-10}) + (1.26 \times 10^{-10}) \quad (4-27)$$

$$UH_s = (4.90 \times 10^{-6}) + (6.58 \times 10^{-6}) + (3.21 \times 10^{-6})$$

or

$$UR_s = 4.49 \times 10^{-10}$$

$$UH_s = 1.47 \times 10^{-5}$$

Because a unit concentration of 1.0 mg/kg was used in the example dermal and incidental ingestion intake equations, and the intakes respond linearly to changes in concentration, 4.49×10^{-10} and 1.47×10^{-5} represent unit risk and unit hazard factors. That is, each additional milligram per kilogram of 1,1-dichloroethane in soil increases carcinogenic risk by 4.49×10^{-10} and toxic hazard by 1.47×10^{-5} .

Tables 4-6 and 4-7 present the aggregate unit risk values calculated for the construction worker and commercial/industrial user, respectively.

TABLE 4-6
AGGREGATE UNIT RISK VALUES FOR CONSTRUCTION WORKER
VIA SOIL EXPOSURE PATHWAYS

Constituent	Unit HQ	Unit ILCR	Unit Risk
1-butanol	1.01E-05	NA	1.01E-05
1,1-dichloroethane	1.46E-05	4.49E-10	4.49E-10
1,1-dichloroethene	1.83E-03	6.37E-08	6.37E-08
1,1,1,2-tetrachloroethane	4.01E-04	1.54E-09	1.54E-09
1,1,2-trichloroethane	3.16E-04	4.48E-09	4.48E-09
1,1,2,2-tetrachloroethane	NA	1.60E-08	1.60E-08
1,2-dibromo-3-chloropropane	8.37E-03	4.13E-07	4.13E-07
1,2-dibromoethane	2.83E-03	2.06E-07	2.06E-07
1,2-dichlorobenzene	NA	NA	0.00E+00
1,2-dichloroethane	NA	4.84E-09	4.84E-09
1,2-dichloropropane	5.93E-03	1.04E-08	1.04E-08
1,2-diphenylhydrazine	NA	4.92E-08	4.92E-08
1,2,3-trichloropropane	2.02E-04	4.18E-07	4.18E-07
1,2,4-trichlorobenzene	1.15E-03	NA	1.15E-03
1,3-dichloropropene	4.14E-03	1.07E-08	1.07E-08
1,4-dichlorobenzene	3.66E-07	2.31E-09	2.31E-09
2-butanone	6.09E-06	NA	6.09E-06
2-chlorophenol	2.33E-04	NA	2.33E-04
2-methylphenol	2.31E-05	NA	2.31E-05
2-naphthylamine	NA	1.02E-07	1.02E-07
2,4-dichlorophenol	3.84E-03	NA	3.84E-03
2,4-dimethylphenol	5.75E-05	NA	5.75E-05
2,4-dinitrophenol	5.74E-03	NA	5.74E-03
2,4-dinitrotoluene	5.74E-03	1.76E-08	1.76E-08
2,4,5-trichlorophenol	1.15E-05	NA	1.15E-05
2,4,6-trichlorophenol	NA	3.97E-09	3.97E-09
2,6-dinitrotoluene	1.15E-03	3.85E-08	3.85E-08
3,3-dichlorobenzidine	NA	6.79E-08	6.79E-08
4-chloroaniline	2.89E-03	NA	2.89E-03
4-methyl-2-pentanone	1.67E-05	NA	1.67E-05

TABLE 4-6 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
4-methylphenol	2.30E-03	NA	2.30E-03
4,4-ddd	NA	9.69E-09	9.69E-09
4,4-dde	NA	1.37E-08	1.37E-08
4,4-ddt	1.64E-02	1.37E-08	1.37E-08
acenaphthene	2.47E-05	NA	2.47E-05
acetone	1.29E-05	NA	1.29E-05
acrolein	NA	NA	NA
acrylonitrile	1.27E-03	6.28E-08	6.28E-08
aldrin	2.73E-01	6.88E-07	6.88E-07
alpha-bhc	NA	2.55E-07	2.55E-07
aniline	5.43E-05	3.23E-10	3.23E-10
anthracene	4.93E-05	NA	4.93E-05
antimony	2.21E-02	NA	2.21E-02
aroclor 1016	NA	NA	NA
aroclor 1254	2.30E-01	NA	2.30E-01
arsenic	2.26E-02	5.01E-08	5.01E-08
barium	7.93E-05	NA	7.93E-05
benzene	NA	6.98E-09	6.98E-09
benzidine	3.84E-03	2.84E-05	2.84E-05
benzoic acid	2.87E-06	NA	2.87E-06
benzo(a)anthracene	NA	8.74E-08	8.74E-08
benzo(a)pyrene	NA	8.74E-07	8.74E-07
benzo(b)fluoranthene	NA	8.74E-08	8.74E-08
benzo(k)fluoranthene	NA	8.74E-08	8.74E-08
benzyl alcohol	1.16E-05	NA	1.16E-05
benzyl chloride	NA	9.97E-09	9.97E-09
beryllium	1.28E-02	1.77E-12	1.77E-12
beta-bhc	NA	7.27E-08	7.27E-08
beta-chloronaphthalene	NA	NA	NA
bis(2-chloro-1-methylethyl)ether	NA	4.02E-09	4.02E-09
bis(2-chloroethyl)ether	NA	1.45E-07	1.45E-07
bis(2-ethylhexyl)phthalate	NA	4.75E-10	4.75E-10
bromodichloromethane	6.02E-04	7.71E-09	7.71E-09

TABLE 4-6 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
bromoform	5.98E-04	4.58E-10	4.58E-10
bromomethane	NA	NA	NA
cadmium	1.22E-02	3.16E-12	3.16E-12
carbazole	NA	1.13E-09	1.13E-09
carbon disulfide	1.40E-04	NA	1.40E-04
carbon tetrachloride	NA	1.03E-08	1.03E-08
chlordan	1.92E-01	6.81E-08	6.81E-08
chlorobenzene	NA	NA	NA
chloroform	1.34E-03	1.90E-09	1.90E-09
chloromethane	NA	1.35E-09	1.35E-09
chromium iii	6.21E-06	NA	6.21E-06
chromium vi	2.46E-04	1.03E-08	1.03E-08
chrysene	NA	8.74E-09	8.74E-09
cis-1,2-dichloroethylene	1.49E-04	NA	1.49E-04
copper	1.59E-04	NA	1.59E-04
cumene	5.28E-05	NA	5.28E-05
cyanide	2.86E-04	NA	2.86E-04
dibenzo(a,h)anthracene	NA	2.98E-07	2.98E-07
dibromochloromethane	7.19E-05	6.67E-09	6.67E-09
dichlorodifluoromethane	9.34E-05	NA	9.34E-05
dieldrin	1.64E-01	6.47E-07	6.47E-07
diethyl phthalate	1.44E-06	NA	1.44E-06
di-n-butylphthalate	1.15E-05	NA	1.15E-05
di-n-octylphthalate	5.74E-04	NA	5.74E-04
endosulfan	1.37E-03	NA	1.37E-03
endrin	2.73E-02	NA	2.73E-02
ethyl chloride	1.41E-06	NA	1.41E-06
ethylbenzene	NA	NA	NA
fluoranthene	2.87E-05	NA	2.87E-05
fluorene	2.88E-05	NA	2.88E-05
gamma-bhc	2.65E-03	4.31E-08	4.31E-08
heptachlor	2.48E-02	3.49E-07	3.49E-07
heptachlor epoxide	6.36E-01	5.30E-07	5.30E-07

TABLE 4-6 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
hexachlorobenzene	NA	1.03E-07	1.03E-07
hexachlorobutadiene	NA	4.47E-09	4.47E-09
hexachlorocyclopentadiene	2.25E-03	NA	2.25E-03
hexachloroethane	1.16E-03	2.23E-09	2.23E-09
indeno(1,2,3-cd)pyrene	NA	6.79E-08	6.79E-08
isobutyl alcohol	4.16E-06	NA	4.16E-06
isophorone	5.77E-06	5.41E-11	5.41E-11
mercury	2.95E-02	NA	2.95E-02
methoxychlor	2.30E-03	NA	2.30E-03
methyl methacrylate	1.88E-04	NA	1.88E-04
methylene bromide	1.32E-04	NA	1.32E-04
methylene chloride	1.87E-04	8.40E-10	8.40E-10
methyl-tert-butyl ether	NA	NA	0.00E+00
molybdenum	1.61E-04	NA	1.61E-04
n-butylbenzyl phthalate	5.75E-05	NA	5.75E-05
nickel	8.37E-04	1.92E-13	1.92E-13
nitroaniline, o-	2.48E-05	NA	2.48E-05
nitrobenzene	2.32E-03	NA	2.32E-03
nitrosodiphenylamine, p-	NA	1.25E-09	1.25E-09
n-nitrosodimethylamine	NA	3.85E-06	3.85E-06
n-nitroso-di-n-propylamine	NA	4.03E-07	4.03E-07
n-nitrosodiphenylamine	NA	5.09E-10	5.09E-10
o-chlorotoluene	6.38E-05	NA	6.38E-05
p-chloro-m-cresol	5.75E-06	NA	5.75E-06
pentachlorophenol	6.57E-04	1.75E-09	1.75E-09
phenol	1.92E-05	NA	1.92E-05
pyrene	8.52E-05	NA	8.52E-05
selenium	1.10E-03	NA	1.10E-03
silver	1.54E-03	NA	1.54E-03
styrene	6.62E-07	NA	6.62E-07
tetrachloroethene	1.23E-04	2.98E-09	2.98E-09
toluene	6.42E-06	NA	6.42E-06
toxaphene	NA	6.81E-08	6.81E-08

TABLE 4-6 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
trans-1,2-dichloroethene	7.47E-05	NA	7.47E-05
trichloroethene	NA	9.56E-10	9.56E-10
trichlorofluoromethane	1.95E-05	NA	1.95E-05
vanadium	2.39E-03	NA	2.39E-03
vinyl acetate	3.70E-05	NA	3.70E-05
vinyl chloride	NA	1.94E-07	1.94E-07
xylenes	6.14E-06	NA	6.14E-06
zinc	2.29E-05	NA	2.29E-05

NOTES:

NA = Not Available. No toxicity data exist for pathways.

TABLE 4-7
AGGREGATE UNIT RISK VALUES FOR COMMERCIAL/INDUSTRIAL USER
VIA SOIL EXPOSURE PATHWAYS

Constituent	Unit HQ	Unit ILCR	Unit Risk
1-butanol	5.78E-06	NA	5.78E-06
1,1-dichloroethane	3.13E-06	9.11E-10	9.11E-10
1,1-dichloroethene	6.16E-05	2.38E-07	2.38E-07
1,1,1,2-tetrachloroethane	2.50E-07	6.97E-11	6.97E-11
1,1,2-trichloroethane	7.71E-06	7.93E-10	7.93E-10
1,1,2,2-tetrachloroethane	NA	6.68E-10	6.68E-10
1,2-dibromo-3-chloropropane	9.37E-05	1.34E-08	1.34E-08
1,2-dibromoethane	1.06E-03	5.43E-09	5.43E-09
1,2-dichlorobenzene	7.58E-08	NA	7.58E-08
1,2-dichloroethane	NA	3.76E-09	3.76E-09
1,2-dichloropropane	5.36E-03	1.38E-07	1.38E-07
1,2-diphenylhydrazine	NA	4.24E-15	4.24E-15
1,2,3-trichloropropane	1.63E-06	2.45E-08	2.45E-08
1,2,4-trichlorobenzene	4.22E-09	NA	4.22E-09
1,3-dichloropropene	1.34E-05	1.51E-09	1.51E-09
1,4-dichlorobenzene	7.01E-09	2.29E-11	2.29E-11
2-butanone	8.51E-08	NA	8.51E-08
2-chlorophenol	1.71E-07	NA	1.71E-07
2-methylphenol	2.64E-09	NA	2.64E-09
2-naphthylamine	NA	6.13E-13	6.13E-13
2,4-dichlorophenol	8.99E-09	NA	8.99E-09
2,4-dimethylphenol	4.58E-10	NA	4.58E-10
2,4-dinitrophenol	2.80E-11	NA	2.80E-11
2,4-dinitrotoluene	5.92E-10	1.31E-13	1.31E-13
2,4,5-trichlorophenol	9.04E-10	NA	9.04E-10
2,4,6-trichlorophenol	NA	9.07E-14	9.07E-14
2,6-dinitrotoluene	9.13E-09	2.22E-12	2.22E-12
3,3-dichlorobenzidine	NA	1.33E-15	1.33E-15
4-chloroaniline	3.08E-08	NA	3.08E-08

TABLE 4-7 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
4-methyl-2-pentanone	2.93E-07	NA	2.93E-07
4-methylphenol	4.99E-09	NA	4.99E-09
4,4-ddd	NA	1.00E-15	1.00E-15
4,4-dde	NA	3.54E-13	3.54E-13
4,4-ddt	7.28E-11	4.42E-15	4.42E-15
acenaphthene	1.23E-09	NA	1.23E-09
acetone	4.58E-07	NA	4.58E-07
acrolein	2.48E-03	NA	2.48E-03
acrylonitrile	6.40E-05	1.31E-08	1.31E-08
aldrin	1.95E-07	3.55E-11	3.55E-11
alpha-bhc	NA	4.31E-12	4.31E-12
aniline	1.96E-08	1.14E-14	1.14E-14
anthracene	1.46E-11	NA	1.46E-11
antimony	NA	NA	NA
aroclor 1016	2.72E-07	NA	2.72E-07
aroclor 1254	3.51E-07	NA	3.51E-07
arsenic	NA	NA	NA
barium	NA	NA	NA
benzene	NA	5.84E-09	5.84E-09
benzidine	1.21E-08	6.46E-09	6.46E-09
benzoic acid	3.04E-12	NA	3.04E-12
benzo(a)anthracene	NA	8.84E-16	8.84E-16
benzo(a)pyrene	NA	1.05E-14	1.05E-14
benzo(b)fluoranthene	NA	3.13E-15	3.13E-15
benzo(k)fluoranthene	NA	1.05E-14	1.05E-14
benzyl alcohol	5.25E-10	NA	5.25E-10
benzyl chloride	NA	2.48E-10	2.48E-10
beryllium	NA	NA	NA
beta-bhc	NA	1.01E-13	1.01E-13
beta-chloronaphthalene	8.64E-09	NA	8.64E-09
bis(2-chloro-1-methylethyl)ether	NA	3.41E-11	3.41E-11
bis(2-chloroethyl)ether	NA	1.45E-09	1.45E-09

TABLE 4-7 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
bis(2-ethylhexyl)phthalate	4.65E-12	2.79E-16	2.79E-16
bromodichloromethane	3.66E-07	3.40E-10	3.40E-10
bromoform	2.81E-07	7.81E-12	7.81E-12
bromomethane	1.74E-03	NA	1.74E-03
cadmium	NA	NA	NA
carbazole	NA	1.50E-15	1.50E-15
carbon disulfide	2.84E-06	NA	2.84E-06
carbon tetrachloride	1.98E-04	7.41E-09	7.41E-09
chlordanne	2.51E-07	6.46E-12	6.46E-12
chlorobenzene	7.07E-06	NA	7.07E-06
chloroform	1.54E-05	1.04E-09	1.04E-09
chloromethane	NA	1.35E-08	1.35E-08
chromium iii	NA	NA	NA
chromium vi	NA	NA	NA
chrysene	NA	1.98E-17	1.98E-17
cis-1,2-dichloroethene	2.66E-05	NA	2.66E-05
copper	NA	NA	NA
cumene	3.49E-06	NA	3.49E-06
cyanide	NA	NA	NA
dibenzo(a,h)anthracene	NA	1.58E-18	1.58E-18
dibromochloromethane	9.69E-06	6.50E-09	6.50E-09
dichlorodifluoromethane	2.85E-04	NA	2.85E-04
ieldrin	1.51E-07	4.30E-11	4.30E-11
diethyl phthalate	3.32E-11	NA	3.32E-11
di-n-butylphthalate	4.77E-10	NA	4.77E-10
di-n-octylphthalate	1.11E-11	NA	1.11E-11
endosulfan	9.33E-10	NA	9.33E-10
endrin	1.46E-09	NA	1.46E-09
ethyl chloride	1.28E-07	NA	1.28E-07
ethylbenzene	2.73E-07	NA	2.73E-07
fluoranthene	6.60E-12	NA	6.60E-12
fluorene	1.43E-09	NA	1.43E-09

TABLE 4-7 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
gamma-bhc	3.22E-08	3.80E-12	3.80E-12
heptachlor	5.52E-07	5.62E-10	5.62E-10
heptachlor epoxide	1.23E-05	7.41E-10	7.41E-10
hexachlorobenzene	6.94E-07	3.57E-10	3.57E-10
hexachlorobutadiene	2.52E-06	1.40E-11	1.40E-11
hexachlorocyclopentadiene	2.04E-04	NA	2.04E-04
hexachloroethane	3.01E-07	4.19E-12	4.19E-12
indeno(1,2,3-cd)pyrene	NA	8.15E-18	8.15E-18
isobutyl alcohol	7.84E-08	NA	7.84E-08
isophorone	5.04E-10	3.42E-14	3.42E-14
mercury	NA	NA	NA
methoxychlor	1.35E-10	NA	1.35E-10
methyl methacrylate	3.60E-06	NA	3.60E-06
methylene bromide	7.27E-06	NA	7.27E-06
methylene chloride	7.38E-07	7.91E-10	7.91E-10
methyl-tert-butyl ether	1.44E-07	NA	1.44E-07
molybdenum	NA	NA	NA
n-butylbenzyl phthalate	3.07E-11	NA	3.07E-11
nickel	NA	NA	NA
nitroaniline, o-	8.18E-08	NA	8.18E-08
nitrobenzene	1.12E-06	NA	1.12E-06
nitrosodiphenylamine, p-	NA	9.71E-14	9.71E-14
n-nitrosodimethylamine	NA	7.27E-05	7.27E-05
n-nitroso-di-n-propylamine	NA	2.24E-09	2.24E-09
n-nitrosodiphenylamine	NA	2.09E-16	2.09E-16
o-chlorotoluene	1.90E-06	NA	1.90E-06
p-chloro-m-cresol	NA	NA	NA
pentachlorophenol	1.68E-10	3.24E-14	3.24E-14
phenol	6.37E-11	NA	6.37E-11
pyrene	4.87E-12	NA	4.87E-12
selenium	NA	NA	NA
silver	NA	NA	NA

TABLE 4-7 (CONT.)

Constituent	Unit HQ	Unit ILCR	Unit Risk
styrene	2.64E-08	NA	2.64E-08
tetrachloroethene	1.77E-06	1.33E-10	1.33E-10
toluene	8.28E-07	NA	8.28E-07
toxaphene	NA	1.09E-11	1.09E-11
trans-1,2-dichloroethene	1.36E-05	NA	1.36E-05
trichloroethene	NA	7.21E-10	7.21E-10
trichlorofluoromethane	4.09E-06	NA	4.09E-06
vanadium	NA	NA	NA
vinyl acetate	8.65E-07	NA	8.65E-07
vinyl chloride	NA	5.53E-06	5.53E-06
xlenes	7.66E-09	NA	7.66E-09
zinc	NA	NA	NA

NOTE:

NA = Not Available. No toxicity data exist for pathway.

5. DEVELOPMENT OF HEALTH-BASED REMEDIATION GOALS

Section 5 describes how the unit risk values calculated in Section 3 are used to quantify chemical-specific, health-based remediation goals (HBRGs) for the identified receptors in Parcel A. Section 5 also describes how these *initial* HBRGs must undergo a final evaluation to ensure that the resultant *final* HBRGs are both health protective and reasonable.

Section 5.1 discusses the health protection levels used in the development of the initial HBRGs. Section 5.2 describes the methodology used to calculate the initial HBRGs and summarizes the goals developed for the on-property construction worker and commercial/industrial user. The approach used to finalize the remediation goals for both organic and inorganic constituents is presented Section 5.3, as are the final HBRGs for Parcel A surface soils.

5.1 HEALTH PROTECTION LEVELS

As previously mentioned, one goal of the National Contingency Plan is to manage total site-wide cancer risk such that the sum of all exposures does not exceed 10^{-4} (EPA 1990a). Although the upper limit of the incremental lifetime cancer risk (ILCR) target range is generally used to make risk management decisions – particularly in determining whether remedial actions are necessary or warranted - EPA does not consider 10^{-4} an absolute limit. Risks below that level may be considered generally acceptable based on site-specific conditions and land use (EPA 1991). For the purpose of developing conservative HBRGs for Parcel A, the value of 10^{-6} was used for calculations in this report. This is a very conservative value, 100 times more conservative than the EPA's target and 10 times more conservative than California Proposition 65's "no significant risk" level.

For noncarcinogenic compounds, EPA indicates that the cumulative site hazard index (HI) should be less than 1 (EPA 1989a). However, no EPA guidance is available on apportioning the allowable level among the range of constituents in various environmental media. The most relevant guidance is provided by the Office of Drinking Water which, in calculating maximum contaminant level goals (MCLGs), uses a relative source contribution (RSC) factor to account for other sources of exposure (EPA 1989a). The RSC value assumed in this report is 0.2, five times more conservative than the standard EPA value of 1.

5.2 CALCULATION OF INITIAL HEALTH-BASED REMEDIATION GOALS

Relevant methodologies for calculating potential human health effects are set forth in recent EPA guidance such as the Risk Assessment Guidance for Superfund (RAGS) Human Health Evaluation Manual (EPA 1989a) and its supporting documents. Exposures are first quantified using a set of equations and parameters unique to each exposure pathway as presented in Section 4 of this report.

The exposure assessment process estimates daily intakes, expressed in milligrams per kilogram-day (mg/kg-d), for hazardous chemicals. The calculated intakes are then multiplied by an appropriate cancer slope factor (CSF) to calculate ILCR or divided by a chemical's reference dose (RfD) to yield an HQ. The calculation of a unit risk (risk per unit of concentration) involves merely the substitution of 1 for the concentration term in a standard intake equation. This unit intake is then either multiplied by a CSF to calculate a unit risk or divided by an RfD to calculate a unit hazard value.

The slope factors cited in IRIS (EPA 1997) and HEAST (EPA 1995) are assumed to be linear below risk levels of 10^{-2} . Thus, because risks are assumed to be linear within the acceptable risk range (10^{-6} to 10^{-4}), these exposure equations can be used to calculate acceptable risk-based concentrations or HBRGs. The general procedures for rearranging these standard risk equations for HBRG calculation are provided by EPA (1991).

HBRGs were established for the redeveloped Parcel A by considering potential future land uses, receptors, exposure parameters, and analytes applicable for site characterization. Generally, risk-based values are derived independent of site concentrations and consider only the receptor's potential exposure (or contact rate) to a particular medium. This contact rate without regard to site concentration is consistent with the unit risk approach previously described.

For this report, a compound-specific HBRG in a distinct environmental medium is evaluated after considering all exposure pathways applicable to the receptor within that medium. As a result, a single equation to calculate these values would be too unwieldy to present here. To simplify the presentation, this section incorporates the cumulative, receptor-specific unit risk values derived in Section 4. Thus, the relationship between unit risk or unit hazard and a medium-specific HBRG can be described with a simplified standard equation, as follows:

$$HBRG = ARL / UF \quad (5-1)$$

where

- HBRG = medium-specific health-based remediation goal (e.g., mg/kg chemical in soil)
ARL = an acceptable risk level (target risk) or an acceptable hazard value
(10^{-6} ILCR, 0.2 HI)
UF = unit factor (unit risk for carcinogenic effects, unit hazard for toxic effects)

Using the construction scenario as an example and inserting the construction worker unit risk and unit hazard for 1,1-dichloroethane soil exposures into the equation, and assuming target risk levels of 10^{-6} (carcinogenic effects) and 0.2 (toxic effects), HBRGs for 1,1-dichloroethane in soil are calculated as follows:

<u>Carcinogens</u>	<u>Toxicants</u>	(5-2)
$HBRG = 1 \times 10^{-6} / 4.49 \times 10^{-10}$	$HBRG = 0.2 / 1.47 \times 10^{-5}$	
<i>or</i>	<i>or</i>	
$HBRG = 2.23 \times 10^3 \text{ mg/kg}$	$HBRG = 1.37 \times 10^4 \text{ mg/kg}$	

For chemicals similar to 1,1-dichloroethane in which both carcinogenic and toxic effects are documented, the lowest value (either that based on an ILCR of 10^{-6} or that based on an HQ of 0.2) was selected. Table 5-1 and 5-2 presents the initial HBRGs for soil exposures as calculated for the construction worker and commercial/industrial user, respectively. Appendix D presents the complete calculation sheets for the HBRGs under the interim construction scenario.

5.3 FINAL HEALTH-BASED REMEDIATION GOALS FOR SURFACE SOILS

The finalization of remediation goals is different for organic and inorganic compounds. The initial HBRGs developed for organic constituents evaluated in this report have focused on two distinct exposure scenarios and must be normalized to ensure health protectiveness prior to setting final HBRGs. Final HBRGs for inorganic compounds must account for the potential impact of naturally occurring background concentrations. The following presents the methodology used for both organic and inorganic compounds in the derivation of final HBRGs.

5.3.1 Final Health-Based Remediation Goals for Organic Compounds

To ensure health protectiveness under both the interim construction and commercial/industrial scenarios, the final HBRG must represent the lowest value from the two receptor scenarios for soil. Table 5-3 compares the initial HBRGs developed for each of the exposure scenarios and presents the adopted final HBRGs for organic constituents in Parcel A soils.

5.3.2 Final Health-Based Remediation Goals for Inorganic Compounds

Numerous inorganic compounds evaluated at the site occur in native, uncontaminated soils. In addition, the environmental concentrations of some inorganic compounds have been increased by general human activity. Inorganic constituents that have been added to the environment as a result of regional human activity, such as automobile emissions, are referred to as anthropogenic (or man-made) background constituents. Anthropogenic background levels must be accounted for in the finalization of remediation goals, to ensure that existing inorganic background concentrations do not bias the remedial effort.

In three sampling events between 1994 and 1996, Geraghty & Miller (G&M 1996) collected samples from various depths at the adjacent ILM site in an effort to establish background concentrations. The findings of its investigation have been reviewed and approved by DTSC, and have been found to meet the data quality objectives required for inclusion in a quantitative human-health risk assessment. Because the ILM site is adjacent to the McDonnell Douglas C-6 facility and the two properties have very similar lithology, the ILM background values are the most site-specific background levels available for the C-6 facility. Table 5-4 summarizes the calculated ILM background concentrations. Appendix E presents the Background Evaluation section from the Lockheed Martin ILM Baseline Risk Assessment (G&M 1996).

Final HBRGs for inorganic compounds were determined by comparing the initial HBRGs to site-specific background concentrations. This was performed for all inorganic analytes, and the higher of the two values was adopted as the final HBRG for the Parcel A remedial operation. It is important to note that the initial HBRGs used in this comparison represent the lowest value from the two receptor scenarios for soil. This ensures that the initial HBRG used in the comparison process is health protective, regardless of the receptor-exposure assumed. The following example illustrates the final HBRG selection process for arsenic in soils:

1. Of the two exposure scenarios (on-property construction worker and commercial/industrial user), identify the most conservative (i.e., lowest) initial HBRG in soils. For arsenic, the construction worker (8.87×10^0 mg/kg) is the lowest.
2. Identify the naturally occurring background concentration (14 mg/kg).
3. Select the initial HBRG or background concentration, whichever is higher. For arsenic, the naturally occurring background concentration (14 mg/kg) is higher than the initial HBRG (8.87 mg/kg) and therefore serves as the final HBRG for arsenic.

Tables 5-4 compares the inorganic initial HBRGs and background concentrations and presents the adopted final HBRGs for inorganic compounds in Parcel A surface soils.

TABLE 5-1
INITIAL HEALTH-BASED REMEDIATION GOALS (HBRGs)
FOR SOIL EXPOSURE PATHWAYS (mg/kg),
BASED ON THE CONSTRUCTION WORKER

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
1-butanol	1.98E+04	NA	1.98E+04
1,1-dichloroethane	1.37E+04	2.23E+03	2.23E+03
1,1-dichloroethene	1.09E+02	1.57E+01	1.57E+01
1,1,1,2-tetrachloroethane	4.98E+02	6.48E+02	4.98E+02
1,1,2-trichloroethane	6.34E+02	2.23E+02	2.23E+02
1,1,2,2-tetrachloroethane	NA	6.25E+01	6.25E+01
1,2-dibromo-3-chloropropane	2.39E+01	2.42E+00	2.42E+00
1,2-dibromoethane	7.06E+01	4.86E+00	4.86E+00
1,2-dichlorobenzene	NA	NA	NA
1,2-dichloroethane	NA	2.06E+02	2.06E+02
1,2-dichloropropane	3.37E+01	9.61E+01	3.37E+01
1,2-diphenylhydrazine	NA	2.03E+01	2.03E+01
1,2,3-trichloropropane	9.90E+02	2.39E+00	2.39E+00
1,2,4-trichlorobenzene	1.74E+02	NA	1.74E+02
1,3-dichloropropene	4.83E+01	9.36E+01	4.83E+01
1,4-dichlorobenzene	5.46E+05	4.32E+02	4.32E+02
2-butanone	3.28E+04	NA	3.28E+04
2-chlorophenol	8.57E+02	NA	8.57E+02
2-methylphenol	8.66E+03	NA	8.66E+03
2-naphthylamine	NA	9.81E+00	9.81E+00
2,4-dichlorophenol	5.21E+01	NA	5.21E+01
2,4-dimethylphenol	3.48E+03	NA	3.48E+03
2,4-dinitrophenol	3.49E+01	NA	3.49E+01
2,4-dinitrotoluene	3.48E+01	5.70E+01	3.48E+01
2,4,5-trichlorophenol	1.73E+04	NA	1.73E+04
2,4,6-trichlorophenol	NA	2.52E+02	2.52E+02
2,6-dinitrotoluene	1.74E+02	2.59E+01	2.59E+01

TABLE 5-1 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
3,3-dichlorobenzidine	NA	1.47E+01	1.47E+01
4-chloroaniline	6.93E+01	NA	6.93E+01
4-methyl-2-pentanone	1.20E+04	NA	1.20E+04
4-methylphenol	8.69E+01	NA	8.69E+01
4,4-ddd	NA	1.03E+02	1.03E+02
4,4-dde	NA	7.28E+01	7.28E+01
4,4-ddt	1.22E+01	7.28E+01	1.22E+01
acenaphthene	8.10E+03	NA	8.10E+03
acetone	1.55E+04	NA	1.55E+04
acrolein	NA	NA	NA
acrylonitrile	1.57E+02	1.59E+01	1.59E+01
aldrin	7.32E-01	1.45E+00	7.32E-01
alpha-bhc	NA	3.93E+00	3.93E+00
aniline	3.69E+03	3.10E+03	3.10E+03
anthracene	4.06E+03	NA	4.06E+03
antimony	9.05E+00	NA	9.05E+00
aroclor 1016	NA	NA	NA
aroclor 1254	8.70E-01	NA	8.70E-01
arsenic	8.87E+00	2.00E+01	8.87E+00
barium	2.52E+03	NA	2.52E+03
benzene	NA	1.43E+02	1.43E+02
benzidine	5.21E+01	3.52E-02	3.52E-02
benzoic acid	6.96E+04	NA	6.96E+04
benzo(a)anthracene	NA	1.14E+01	1.14E+01
benzo(a)pyrene	NA	1.14E+00	1.14E+00
benzo(b)fluoranthene	NA	1.14E+01	1.14E+01
benzo(k)fluoranthene	NA	1.14E+01	1.14E+01
benzyl alcohol	1.73E+04	NA	1.73E+04
benzyl chloride	NA	1.00E+02	1.00E+02
beryllium	1.56E+01	5.65E+05	1.56E+01
beta-bhc	NA	1.38E+01	1.38E+01

TABLE 5-1 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
beta-chloronaphthalene	NA	NA	NA
bis(2-chloro-1-methylethyl)ether	NA	2.49E+02	2.49E+02
bis(2-chloroethyl)ether	NA	6.91E+00	6.91E+00
bis(2-ethylhexyl)phthalate	NA	2.10E+03	2.10E+03
bromodichloromethane	3.32E+02	1.30E+02	1.30E+02
bromoform	3.34E+02	2.18E+03	3.34E+02
bromomethane	NA	NA	NA
cadmium	1.64E+01	3.16E+05	1.64E+01
carbazole	NA	8.83E+02	8.83E+02
carbon disulfide	1.43E+03	NA	1.43E+03
carbon tetrachloride	NA	9.71E+01	9.71E+01
chlordan	1.04E+00	1.47E+01	1.04E+00
chlorobenzene	NA	NA	NA
chloroform	1.49E+02	5.27E+02	1.49E+02
chloromethane	NA	7.43E+02	7.43E+02
chromium iii	3.22E+04	NA	3.22E+04
chromium vi	8.14E+02	9.73E+01	9.73E+01
chrysene	NA	1.14E+02	1.14E+02
cis-1,2-dichloroethene	1.34E+03	NA	1.34E+03
copper	1.26E+03	NA	1.26E+03
cumene	3.79E+03	NA	3.79E+03
cyanide	6.99E+02	NA	6.99E+02
dibenzo(a,h)anthracene	NA	3.35E+00	3.35E+00
dibromochloromethane	2.78E+03	1.50E+02	1.50E+02
dichlorodifluoromethane	2.14E+03	NA	2.14E+03
ieldrin	1.22E+00	1.54E+00	1.22E+00
diethyl phthalate	1.39E+05	NA	1.39E+05
di-n-butylphthalate	1.74E+04	NA	1.74E+04
di-n-octylphthalate	3.49E+02	NA	3.49E+02
endosulfan	1.46E+02	NA	1.46E+02
endrin	7.33E+00	NA	7.33E+00

TABLE 5-1 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
ethyl chloride	1.42E+05	NA	1.42E+05
ethylbenzene	NA	NA	NA
fluoranthene	6.97E+03	NA	6.97E+03
fluorene	6.94E+03	NA	6.94E+03
gamma-bhc	7.56E+01	2.32E+01	2.32E+01
heptachlor	8.06E+00	2.87E+00	2.87E+00
heptachlor epoxide	3.14E-01	1.89E+00	3.14E-01
hexachlorobenzene	NA	9.69E+00	9.69E+00
hexachlorobutadiene	NA	2.24E+02	2.24E+02
hexachlorocyclopentadiene	8.87E+01	NA	8.87E+01
hexachloroethane	1.73E+02	4.49E+02	1.73E+02
indeno(1,2,3-cd)pyrene	NA	1.47E+01	1.47E+01
isobutyl alcohol	4.81E+04	NA	4.81E+04
isophorone	3.47E+04	1.85E+04	1.85E+04
mercury	6.78E+00	NA	6.78E+00
methoxychlor	8.71E+01	NA	8.71E+01
methyl methacrylate	1.06E+03	NA	1.06E+03
methylene bromide	1.51E+03	NA	1.51E+03
methylene chloride	1.07E+03	1.19E+03	1.07E+03
methyl-tert-butyl ether	NA	NA	NA
molybdenum	1.24E+03	NA	1.24E+03
n-butylbenzyl phthalate	3.48E+03	NA	3.48E+03
nickel	2.39E+02	5.21E+06	2.39E+02
nitroaniline, o-	8.07E+03	NA	8.07E+03
nitrobenzene	8.61E+01	NA	8.61E+01
nitrosodiphenylamine, p-	NA	8.02E+02	8.02E+02
n-nitrosodimethylamine	NA	2.60E-01	2.60E-01
n-nitroso-di-n-propylamine	NA	2.48E+00	2.48E+00
n-nitrosodiphenylamine	NA	1.96E+03	1.96E+03
o-chlorotoluene	3.14E+03	NA	3.14E+03
p-chloro-m-cresol	3.48E+04	NA	3.48E+04

TABLE 5-1 (CONT.)

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
pentachlorophenol	3.04E+02	5.72E+02	3.04E+02
phenol	1.04E+04	NA	1.04E+04
pyrene	2.35E+03	NA	2.35E+03
selenium	1.82E+02	NA	1.82E+02
silver	1.30E+02	NA	1.30E+02
styrene	3.02E+05	NA	3.02E+05
tetrachloroethene	1.62E+03	3.36E+02	3.36E+02
toluene	3.12E+04	NA	3.12E+04
toxaphene	NA	1.47E+01	1.47E+01
trans-1,2-dichloroethene	2.68E+03	NA	2.68E+03
trichloroethene	NA	1.05E+03	1.05E+03
trichlorofluoromethane	1.03E+04	NA	1.03E+04
vanadium	8.37E+01	NA	8.37E+01
vinyl acetate	5.41E+03	NA	5.41E+03
vinyl chloride	NA	5.16E+00	5.16E+00
xylenes	3.26E+04	NA	3.26E+04
zinc	8.73E+03	NA	8.73E+03

NOTES:

NA = Not Available. No toxicity data.

TABLE 5-2
INITIAL HEALTH-BASED REMEDIATION GOALS (HBRGS)
FOR SOIL EXPOSURE PATHWAYS (mg/kg),
BASED ON THE COMMERCIAL/INDUSTRIAL WORKER

Constituent	HBRG HQ=0.2 (mg/kg)	HBRG ILCR=10 ⁻⁶ (mg/kg)	Initial HBRG (mg/kg)
1-butanol	3.46E+04	NA	3.46E+04
1,1-dichloroethane	6.38E+04	1.10E+03	1.10E+03
1,1-dichloroethene	3.24E+03	4.21E+00	4.21E+00
1,1,1,2-tetrachloroethane	8.00E+05	1.44E+04	1.44E+04
1,1,2-trichloroethane	2.59E+04	1.26E+03	1.26E+03
1,1,2,2-tetrachloroethane	NA	1.50E+03	1.50E+03
1,2-dibromo-3-chloropropane	2.13E+03	7.47E+01	7.47E+01
1,2-dibromoethane	1.88E+02	1.84E+02	1.84E+02
1,2-dichlorobenzene	2.64E+06	NA	2.64E+06
1,2-dichloroethane	NA	2.66E+02	2.66E+02
1,2-dichloropropane	3.73E+01	7.25E+00	7.25E+00
1,2-diphenylhydrazine	NA	2.36E+08	2.36E+08
1,2,3-trichloropropane	1.22E+05	4.08E+01	4.08E+01
1,2,4-trichlorobenzene	4.74E+07	NA	4.74E+07
1,3-dichloropropene	1.49E+04	6.63E+02	6.63E+02
1,4-dichlorobenzene	2.85E+07	4.37E+04	4.37E+04
2-butanone	2.35E+06	NA	2.35E+06
2-chlorophenol	1.17E+06	NA	1.17E+06
2-methylphenol	7.59E+07	NA	7.59E+07
2-naphthylamine	NA	1.63E+06	1.63E+06
2,4-dichlorophenol	2.22E+07	NA	2.22E+07
2,4-dimethylphenol	4.37E+08	NA	4.37E+08
2,4-dinitrophenol	7.14E+09	NA	7.14E+09
2,4-dinitrotoluene	3.38E+08	7.62E+06	7.62E+06
2,4,5-trichlorophenol	2.21E+08	NA	2.21E+08
2,4,6-trichlorophenol	NA	1.10E+07	1.10E+07
2,6-dinitrotoluene	2.19E+07	4.51E+05	4.51E+05

Table C-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Intake Equation	=	CS X (I/VF + I/PEF) X EF X ED X ET X IR BW X AT	
IR	Inhalation rate of gases (RAGS, 1989)	2.5E+00 m³/h	
EF	Exposure frequency	9.0E+01 days/year	
EDn	Exposure duration for non-carcinogens	1.0E+00 year	
EDc	Exposure duration for carcinogens	1.0E+00 year	
BW	Body weight	7.0E+01 kg	
ATc	Average time for carcinogens (lifetime)	2.6E+04 days	
ATn	Average time for non-carcinogens (EDn x 365)	1.3E+02 days	
ET	Exposure time	8.0E+00 h/d	
CS	Concentration of chemicals in soil	(see table below)	
VF	Volatilization Factor	(see table below)	
PEF	Particulate Emission Factor	(see table below)	
Chemical Concentrations			
Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)
ethylbenzene	1.1E+05	4.8E+09	1.0E+00
fluoranthene	6.1E+07	4.8E+09	1.0E+00
fluorene	4.1E+06	4.8E+09	1.0E+00
gamma-hbc	1.0E+07	4.8E+09	1.0E+00
heptachlor	1.9E+06	4.8E+09	1.0E+00
heptachlor epoxide	2.5E+06	4.8E+09	1.0E+00
hexachlorobenzene	1.3E+06	4.8E+09	1.0E+00
hexachlorobutadiene	1.4E+06	4.8E+09	1.0E+00
hexachlorocyclopentadiene	4.9E+05	4.8E+09	1.0E+00
hexachlorothane	1.8E+06	4.8E+09	1.0E+00
indeno[1,2,3-cd]pyrene	4.1E+09	4.8E+09	1.0E+00
isobutyl alcohol	2.0E+05	4.8E+09	1.0E+00
isophorone	3.1E+06	4.8E+09	1.0E+00
mercury	NA	4.8E+09	1.0E+00
methoxychlor	3.8E+07	4.8E+09	1.0E+00
methyl methacrylate	5.7E+04	4.8E+09	1.0E+00

Table C-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
ethylbenzene	1.8E-06	NA	NA	9.1E-09	NA	NA
fluoranthene	3.4E-09	4.0E-01	8.5E-09	1.7E-11	NA	NA
fluorene	4.9E-08	4.0E-01	1.2E-07	2.4E-10	NA	NA
gamma-bhc	2.0E-08	3.0E-03	6.8E-06	1.0E-10	1.1E+00	1.1E-10
heptachlor	1.1E-07	5.0E-04	2.2E-04	5.4E-10	5.7E+00	3.1E-09
heptachlor epoxide	8.3E-08	1.3E-05	6.4E-03	4.1E-10	1.3E+01	5.3E-09
hexachlorobenzene	1.5E-07	NA	NA	7.6E-10	1.8E+00	1.4E-09
hexachlorobutadiene	1.5E-07	NA	NA	7.2E-10	7.8E-02	5.6E-11
hexachlorocyclopentadiene	4.2E-07	2.0E-04	2.1E-03	2.1E-09	NA	NA
hexachloroethane	1.1E-07	1.0E-02	1.1E-05	5.6E-10	3.9E-02	2.2E-11
indeno(1,2,3-cd)pyrene	9.3E-11	NA	NA	4.6E-13	3.9E-01	1.8E-13
isobutyl alcohol	1.0E-06	3.0E+00	3.3E-07	5.0E-09	NA	NA
isophorone	6.6E-08	2.0E+00	3.3E-08	3.2E-10	9.5E-04	3.1E-13
mercury	4.3E-11	8.6E-05	5.0E-07	2.1E-13	NA	NA
methoxychlor	5.4E-09	5.0E-03	1.1E-06	2.7E-11	NA	NA
methyl methacrylate	3.6E-06	8.0E-02	4.5E-05	1.8E-08	NA	NA
methylene bromide	1.8E-06	1.0E-01	1.8E-05	8.7E-09	NA	NA
methylene chloride	5.4E-06	8.6E-01	6.3E-06	2.7E-08	3.5E-03	9.4E-11
methyl-tert-butyl ether	2.3E-06	NA	NA	1.1E-08	NA	NA
molybdenum	4.3E-11	4.0E-02	1.1E-09	2.1E-13	NA	NA
n-butylbenzyl phthalate	1.6E-08	2.0E-01	8.1E-08	8.0E-11	NA	NA
nickel	4.3E-11	2.0E-02	2.1E-09	2.1E-13	9.1E-01	1.9E-13
nitroaniline, o-	1.4E-08	5.7E-04	2.5E-05	7.0E-11	NA	NA
nitrobenzene	1.7E-07	5.7E-03	2.9E-05	8.2E-10	NA	NA
nitrosodiphenylamine, p-	2.3E-08	NA	NA	1.1E-10	2.2E-02	2.5E-12
n-nitrosodimethylamine	3.7E-05	NA	NA	1.8E-07	1.6E+01	2.9E-06
n-nitroso-di-n-propylamine	2.0E-07	NA	NA	9.6E-10	7.0E+00	6.8E-09
n-nitrosodiphenylamine	1.7E-09	NA	NA	8.4E-12	9.0E-03	7.6E-14
o-chlorotoluene	1.3E-06	2.0E-01	6.4E-06	6.3E-09	NA	NA
p-chloro-m-cresol	3.3E-08	2.0E+00	1.7E-08	1.6E-10	NA	NA

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RfD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
ethylbenzene	1.8E-06	NA	NA	9.1E-09	NA	NA
fluoranthene	3.4E-09	4.0E-01	8.5E-09	1.7E-11	NA	NA
fluorene	4.9E-08	4.0E-01	1.2E-07	2.4E-10	NA	NA
gamma-bhc	2.0E-08	3.0E-03	6.8E-06	1.0E-10	1.1E+00	1.1E-10
heptachlor	1.1E-07	5.0E-04	2.2E-04	5.4E-10	5.7E+00	3.1E-09
heptachlor epoxide	8.3E-08	1.3E-05	6.4E-03	4.1E-10	1.3E+01	5.3E-09
hexachlorobenzene	1.5E-07	NA	NA	7.6E-10	1.8E+00	1.4E-09
hexachlorobutadiene	1.5E-07	NA	NA	7.2E-10	7.8E-02	5.6E-11
hexachlorocyclopentadiene	4.2E-07	2.0E-04	2.1E-03	2.1E-09	NA	NA
hexachloroethane	1.1E-07	1.0E-02	1.1E-05	5.6E-10	3.9E-02	2.2E-11
indeno(1,2,3-cd)pyrene	9.3E-11	NA	NA	4.6E-13	3.9E-01	1.8E-13
isobutyl alcohol	1.0E-06	3.0E+00	3.3E-07	5.0E-09	NA	NA
isophorone	6.6E-08	2.0E+00	3.3E-08	3.2E-10	9.5E-04	3.1E-13
mercury	4.3E-11	8.6E-05	5.0E-07	2.1E-13	NA	NA
methoxychlor	5.4E-09	5.0E-03	1.1E-06	2.7E-11	NA	NA
methyl methacrylate	3.6E-06	8.0E-02	4.5E-05	1.8E-08	NA	NA
methylene bromide	1.8E-06	1.0E-01	1.8E-05	8.7E-09	NA	NA
methylene chloride	5.4E-06	8.6E-01	6.3E-06	2.7E-08	3.5E-03	9.4E-11
methyl-tert-butyl ether	2.3E-06	NA	NA	1.1E-08	NA	NA
molybdenum	4.3E-11	4.0E-02	1.1E-09	2.1E-13	NA	NA
n-butylbenzyl phthalate	1.6E-08	2.0E-01	8.1E-08	8.0E-11	NA	NA
nickel	4.3E-11	2.0E-02	2.1E-09	2.1E-13	9.1E-01	1.9E-13
nitroaniline, o-	1.4E-08	5.7E-04	2.5E-05	7.0E-11	NA	NA
nitrobenzene	1.7E-07	5.7E-03	2.9E-05	8.2E-10	NA	NA
nitrosodiphenylamine, p-	2.3E-08	NA	NA	1.1E-10	2.2E-02	2.5E-12
n-nitrosodimethylamine	3.7E-05	NA	NA	1.8E-07	1.6E+01	2.9E-06
n-nitroso-di-n-propylamine	2.0E-07	NA	NA	9.6E-10	7.0E+00	6.8E-09
n-nitrosodiphenylamine	1.7E-09	NA	NA	8.4E-12	9.0E-03	7.6E-14
o-chlorotoluene	1.3E-06	2.0E-01	6.4E-06	6.3E-09	NA	NA
p-chloro-m-cresol	3.3E-08	2.0E+00	1.7E-08	1.6E-10	NA	NA

Table C-1
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Intake Equation	=	CS X ((VF + 1/PEF) X EF X ED X ET X IR BW X AT)					
IR	Inhalation rate of gases (RAGS, 1989)	2.5E+00 m³/h					
EF	Exposure frequency	9.0E-01 days/year					
EDn	Exposure duration for non-carcinogens	1.0E+00 year					
EDc	Exposure duration for carcinogens	1.0E+00 year					
BW	Body weight	7.0E+01 kg					
ATc	Average time for carcinogens (lifetime)	2.6E+04 days					
ATn	Average time for non-carcinogens (EDn x 365)	1.3E+02 days					
ET	Exposure time	8.0E+00 h/d					
CS	Concentration of chemicals in soil	(see table below)					
VF	Volatilization Factor	(see table below)					
PEF	Particulate Emission Factor	(see table below)					
Chemical Concentrations							
Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)	Compound	VF (m³/kg)	PEF (m³/kg)	CS (mg/kg)
pentachlorophenol	1.4E+07	4.8E+09	1.0E+00	zinc	NA	4.8E+09	1.0E+00
phenol	5.1E+06	4.8E+09	1.0E+00				
pyrene	8.2E+07	4.8E+09	1.0E+00				
selenium	NA	4.8E+09	1.0E+00				
silver	NA	4.8E+09	1.0E+00				
styrene	3.6E+05	4.8E+09	1.0E+00				
tetrachloroethene	2.3E+05	4.8E+09	1.0E+00				
toluene	1.0E+05	4.8E+09	1.0E+00				
toxaphene	6.2E+06	4.8E+09	1.0E+00				
trans-1,2-dichloroethene	5.9E+04	4.8E+09	1.0E+00				
trichloroethene	6.9E+04	4.8E+09	1.0E+00				
trichlorofluoromethane	3.3E+04	4.8E+09	1.0E+00				
vanadium	NA	4.8E+09	1.0E+00				
vinyl acetate	1.4E+05	4.8E+09	1.0E+00				
vinyl chloride	1.5E+03	4.8E+09	1.0E+00				
xylenes	2.5E+05	4.8E+09	1.0E+00				

Table C-1 (cont.)
Summary of Unit Risk Characterization
On-Property Construction Worker
Via Inhalation of Particulates and Volatiles

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RID (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹
pentachlorophenol	1.5E-08	3.0E-02	4.9E-07	pentachlorophenol	7.3E-11	1.8E-02
phenol	4.0E-08	6.0E-01	6.7E-08	phenol	2.0E-10	NA
pyrene	2.5E-09	3.0E-01	8.5E-09	pyrene	1.3E-11	NA
selenium	4.3E-11	5.0E-03	8.5E-09	selenium	2.1E-13	NA
silver	4.3E-11	5.0E-03	8.5E-09	silver	2.1E-13	NA
styrene	5.7E-07	8.6E-01	6.6E-07	styrene	2.8E-09	NA
tetrachloroethene	8.7E-07	1.0E-01	8.7E-06	tetrachloroethene	4.3E-09	2.1E-02
toluene	2.0E-06	2.0E+00	1.0E-06	toluene	1.0E-08	NA
toxaphene	3.3E-08	NA	NA	toxaphene	1.6E-10	1.2E+00
trans-1,2-dichloroethene	3.5E-06	2.0E-01	1.7E-05	trans-1,2-dichloroethene	1.7E-08	NA
trichloroethene	3.0E-06	NA	NA	trichloroethene	1.5E-08	1.0E-02
trichlorofluoromethane	6.2E-06	2.0E+00	3.1E-06	trichlorofluoromethane	3.1E-08	NA
vanadium	4.3E-11	7.0E-03	6.1E-09	vanadium	2.1E-13	NA
vinyl acetate	1.5E-06	5.7E-02	2.5E-05	vinyl acetate	7.2E-09	NA
vinyl chloride	1.3E-04	NA	NA	vinyl chloride	6.6E-07	2.7E-01
xylenes	8.1E-07	2.0E+00	4.0E-07	xylenes	4.0E-09	NA
zinc	4.3E-11	3.0E-01	1.4E-10	zinc	2.1E-13	NA

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹
pentachlorophenol	4.0E-08	6.0E-01	6.7E-08	pentachlorophenol	7.3E-11	1.8E-02
phenol	2.5E-09	3.0E-01	8.5E-09	phenol	2.0E-10	NA
pyrene	4.3E-11	5.0E-03	8.5E-09	pyrene	1.3E-11	NA
selenium	4.3E-11	5.0E-03	8.5E-09	selenium	2.1E-13	NA
silver	5.7E-07	8.6E-01	6.6E-07	silver	2.1E-13	NA
styrene	8.7E-07	1.0E-01	8.7E-06	styrene	2.8E-09	NA
tetrachloroethene	2.0E-06	2.0E+00	1.0E-06	tetrachloroethene	4.3E-09	2.1E-02
toluene	3.3E-08	NA	NA	toluene	1.0E-08	NA
toxaphene	3.5E-06	2.0E-01	1.7E-05	toxaphene	1.6E-10	1.2E+00
trans-1,2-dichloroethene	3.0E-06	NA	NA	trans-1,2-dichloroethene	1.7E-08	NA
trichloroethene	6.2E-06	2.0E+00	3.1E-06	trichloroethene	1.5E-08	1.0E-02
trichlorofluoromethane	4.3E-11	7.0E-03	6.1E-09	trichlorofluoromethane	3.1E-08	NA
vanadium	1.5E-06	5.7E-02	2.5E-05	vanadium	2.1E-13	NA
vinyl acetate	1.3E-04	NA	NA	vinyl acetate	7.2E-09	NA
vinyl chloride	8.1E-07	2.0E+00	4.0E-07	vinyl chloride	6.6E-07	2.7E-01
xylenes	4.3E-11	3.0E-01	1.4E-10	xylenes	4.0E-09	NA
zinc				zinc	2.1E-13	NA

Table C-2
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Intake Equation	=	CS X EF X ED X ET X IR BW X AT	
IR	Inhalation rate of gases (RAGS, 1989)	8.3E-01 m/h	
EF	Exposure frequency	2.5E+02 days/year	
EDn	Exposure duration for non-carcinogens	2.5E+01 year	
EDc	Exposure duration for carcinogens	2.5E+01 year	
BW	Body weight	7.0E+01 kg	
ATc	Average time for carcinogens (lifetime)	2.6E+04 days	
ATn	Average time for non-carcinogens (EDn x 365)	9.1E+03 days	
ET	Exposure time	8.0E+00 h/d	
Ci	Concentration of chemicals indoors	See Table 4-5	
Chemical Concentrations			
Compound	Concentration (mg/m ³)	Concentration (mg/m ³)	
1-butanol	8.9E-06	2-butanone	3.7E-07
1,1-dichloroethane	6.9E-06	2-chlorophenol	1.3E-08
1,1-dichloroethylene	8.5E-06	2-methylphenol	2.0E-09
1,1,1,2-tetrachloroethane	1.2E-07	2-naphthylamine	1.5E-11
1,1,2-trichloroethane	4.7E-07	2,4-dichlorophenol	4.2E-10
1,1,2,2-tetrachloroethane	1.1E-07	2,4-dimethylphenol	1.4E-10
1,2-dibromo-3-chloropropane	8.2E-08	2,4-dinitrophenol	8.6E-13
1,2-dibromoethane	9.4E-07	2,4-dinitrotoluene	1.8E-11
1,2-dichlorobenzene	6.7E-08	2,4,5-trichlorophenol	1.4E-09
1,2-dichloroethane	2.3E-06	2,4,6-trichlorophenol	5.6E-11
1,2-dichloropropane	9.4E-05	2,6-dinitrotoluene	1.4E-10
1,2-diphenylhydrazine	2.1E-13	3,3-dichlorobenzidine	4.8E-14
1,2,3-trichloropropene	1.5E-07	4-chloroaniline	1.9E-09
1,2,4-trichlorobenzene	3.7E-09	4-methyl-2-pentanone	1.0E-07
1,3-dichloropropene	1.2E-06		
1,4-dichlorobenzene	2.5E-08		

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF	UR (unitless)
1-butanol	5.8E-07	1.0E-01	5.8E-06	1-butanol	NA	NA
1,1-dichloroethane	4.5E-07	1.4E-01	3.1E-06	1,1-dichloroethane	5.7E-03	9.1E-10
1,1-dichloroethene	5.5E-07	9.0E-03	6.2E-05	1,1-dichloroethene	1.6E-07	2.4E-07
1,1,1,2-tetrachloroethane	7.5E-09	3.0E-02	2.5E-07	1,1,1,2-tetrachloroethane	2.0E-07	1.2E+00
1,1,2-trichloroethane	3.1E-08	4.0E-03	7.7E-06	1,1,2-trichloroethane	2.7E-09	2.6E-02
1,1,2,2-tetrachloroethane	6.9E-09	NA	NA	1,1,2,2-tetrachloroethane	1.1E-08	7.2E-02
1,2-dibromo-3-chloropropane	5.4E-09	5.7E-05	9.4E-05	1,2-dibromo-3-chloropropane	2.5E-09	7.2E-01
1,2-dibromoethane	6.1E-08	5.7E-05	1.1E-03	1,2-dibromoethane	1.5E-09	NA
1,2-dichlorobenzene	4.3E-09	5.7E-02	7.6E-08	1,2-dichlorobenzene	5.4E-08	NA
1,2-dichloroethane	1.5E-07	NA	NA	1,2-dichloroethane	7.0E-02	3.8E-09
1,2-dichloropropane	6.1E-06	1.1E-03	5.4E-03	1,2-dichloropropane	2.2E-06	6.3E-02
1,2-diphenylhydrazine	1.4E-14	NA	NA	1,2-diphenylhydrazine	4.9E-15	1.4E-07
1,2,3-trichloropropane	9.8E-09	6.0E-03	1.6E-06	1,2,3-trichloropropane	3.5E-09	4.2E-05
1,2,4-trichlorobenzene	2.4E-10	5.7E-02	4.2E-09	1,2,4-trichlorobenzene	7.0E+00	2.4E-08
1,3-dichloropropene	7.7E-08	5.7E-03	1.3E-05	1,3-dichloropropene	8.6E-11	NA
1,4-dichlorobenzene	1.6E-09	2.3E-01	7.0E-09	1,4-dichlorobenzene	2.7E-08	5.5E-02
2-butanone	2.4E-08	2.9E-01	8.5E-08	2-butanone	5.7E-10	4.0E-02
2-chlorophenol	8.5E-10	5.0E-03	1.7E-07	2-chlorophenol	8.7E-09	NA
2-methylphenol	1.3E-10	5.0E-02	2.6E-09	2-methylphenol	3.1E-10	NA
2-naphthylamine	9.5E-13	NA	NA	2-naphthylamine	4.7E-11	NA
2,4-dichlorophenol	2.7E-11	3.0E-03	9.0E-09	2,4-dichlorophenol	3.4E-13	6.1E-13
2,4-dimethylphenol	9.2E-12	2.0E-02	4.6E-10	2,4-dimethylphenol	9.6E-12	NA
2,4-dinitrophenol	5.6E-14	2.0E-03	2.8E-11	2,4-dinitrophenol	3.3E-12	NA
2,4-dinitrotoluene	1.2E-12	2.0E-03	5.9E-10	2,4-dinitrotoluene	2.0E-14	NA
2,4,5-trichlorophenol	9.0E-11	1.0E-01	9.0E-10	2,4,5-trichlorophenol	4.2E-13	3.1E-01
2,4,6-trichlorophenol	3.6E-12	NA	NA	2,4,6-trichlorophenol	3.2E-11	NA
2,6-dinitrotoluene	9.1E-12	1.0E-03	9.1E-09	2,6-dinitrotoluene	1.3E-12	7.0E-02
3,3-dichlorobenzidine	3.1E-15	NA	NA	3,3-dichlorobenzidine	3.3E-12	6.8E-01
4-chloraniline	1.2E-10	4.0E-03	3.1E-08	4-chloraniline	1.1E-15	1.2E+00
4-methyl-2-pentanone	6.7E-09	2.3E-02	2.9E-07	4-methyl-2-pentanone	4.4E-11	NA

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Intake Equation	=	CS X EF X ED X ET X IR BW X AT
IR	Inhalation rate of gases (RAGS, 1989)	8.3E-01 m³/h
EF	Exposure frequency	2.5E+02 days/year
EDn	Exposure duration for non-carcinogens	2.5E+01 year
EDc	Exposure duration for carcinogens	2.5E+01 year
BW	Body weight	7.0E+01 kg
ATc	Average time for carcinogens (lifETIME)	2.6E+04 days
ATn	Average time for non-carcinogens (EDn x 365)	9.1E+03 days
ET	Exposure time	8.0E+00 h/d
Ci	Concentration of chemicals indoors	See Table 4-5
Chemical Concentrations		
Compound	Concentration (mg/m³)	Concentration (mg/m³)
4-methylphenol	3.8E-10	NA
4,4-did	1.8E-13	2.5E-06
4,4-dde	4.3E-11	5.6E-10
4,4-ddt	5.6E-13	1.9E-10
acenaphthene	1.1E-09	9.8E-14
acetone	7.0E-07	1.2E-13
acrolein	2.2E-07	3.5E-13
acrylonitrile	5.6E-07	benzo(k)fluoranthene
aldrin	9.0E-11	benzyl alcohol
alpha-bhc	2.9E-11	benzyl chloride
aniline	8.6E-11	beryllium
anthracene	6.7E-11	beta-bhc
antimony	NA	beta-chloronaphthalene
aroclor 1016	2.9E-10	bis(2-chloro-1-methylethyl)ether
aroclor 1254	1.1E-10	NA
arsenic	NA	4.2E-08

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d). (unitless)
4-methylphenol	2.5E-11	5.0E-03	5.0E-09	4-methylphenol	8.9E-12	NA
4,4-ddd	1.2E-14	NA	NA	4,4-ddd	4.2E-15	2.4E-01
4,4-dde	2.9E-12	NA	NA	4,4-dde	1.0E-12	3.4E-01
4,4-ddt	3.6E-14	5.0E-04	7.3E-11	4,4-ddt	1.3E-14	3.4E-01
acenaphthene	7.4E-11	6.0E-02	1.2E-09	acenaphthene	2.6E-11	NA
acetone	4.6E-08	1.0E-01	4.6E-07	acetone	1.6E-08	NA
acrolein	1.4E-08	5.7E-06	2.5E-03	acrolein	5.1E-09	NA
acrylonitrile	3.7E-08	5.7E-04	6.4E-05	acrylonitrile	1.3E-08	1.0E+00
aldrin	5.8E-12	3.0E-05	1.9E-07	aldrin	2.1E-12	1.7E+01
alpha-bhc	1.9E-12	NA	NA	alpha-bhc	6.8E-13	6.3E+00
aniline	5.6E-12	2.9E-04	2.0E-08	aniline	2.0E-12	4.3E-12
anthracene	4.4E-12	3.0E-01	1.5E-11	anthracene	5.7E-03	1.1E-14
antimony	NA	4.0E-04	NA	antimony	1.6E-12	NA
aroclor 1016	1.9E-11	7.0E-05	2.7E-07	aroclor 1016	NA	NA
aroclor 1254	7.0E-12	2.0E-05	3.5E-07	aroclor 1254	6.8E-12	NA
arsenic	NA	3.0E-04	NA	arsenic	2.5E-12	NA
barium	NA	1.4E-04	NA	barium	NA	NA
benzene	1.6E-07	NA	NA	benzene	1.2E+01	NA
benzidine	3.6E-11	3.0E-03	1.2E-08	benzidine	NA	NA
benzoic acid	1.2E-11	4.0E-00	3.0E-12	benzoic acid	5.8E-08	5.8E-09
benzo(a)anthracene	6.3E-15	NA	NA	benzo(a)anthracene	1.3E-11	5.0E+02
benzo(a)pyrene	7.5E-15	NA	NA	benzo(a)pyrene	4.3E-12	NA
benzo(b)fluoranthene	2.2E-14	NA	NA	benzo(b)fluoranthene	5.8E-08	6.5E-09
benzo(k)fluoranthene	7.5E-14	NA	NA	benzo(k)fluoranthene	1.3E-11	NA
benzyl alcohol	1.6E-10	3.0E-01	5.3E-10	benzyl alcohol	2.3E-15	8.8E-16
benzyl chloride	4.1E-09	NA	NA	benzyl chloride	2.7E-15	1.0E-14
beryllium	NA	5.0E-03	NA	beryllium	8.0E-15	3.9E+00
beta-bhc	1.6E-13	NA	NA	beta-bhc	2.7E-14	3.9E-01
beta-chloronaphthalene	6.9E-10	8.0E-02	8.6E-09	beta-chloronaphthalene	5.6E-11	1.0E-14
bis(2-chloro-1-methylethyl)ether	2.7E-09	NA	NA	bis(2-chloro-1-methylethyl)ether	1.5E-09	2.5E-10

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	Compound	CDI (mg/kg-d)	CSF (mg/kg-d). (unitless)
4-methylphenol	2.5E-11	5.0E-03	5.0E-09	4-methylphenol	8.9E-12	NA
4,4-ddd	1.2E-14	NA	NA	4,4-ddd	4.2E-15	1.0E-15
4,4-dde	2.9E-12	NA	NA	4,4-dde	1.0E-12	3.5E-13
4,4-ddt	3.6E-14	5.0E-04	7.3E-11	4,4-ddt	1.3E-14	4.4E-15
acenaphthene	7.4E-11	6.0E-02	1.2E-09	acenaphthene	2.6E-11	NA
acetone	4.6E-08	1.0E-01	4.6E-07	acetone	1.6E-08	NA
acrolein	1.4E-08	5.7E-06	2.5E-03	acrolein	5.1E-09	NA
acrylonitrile	3.7E-08	5.7E-04	6.4E-05	acrylonitrile	1.3E-08	1.3E-08
aldrin	5.8E-12	3.0E-05	1.9E-07	aldrin	2.1E-12	3.6E-11
alpha-bhc	1.9E-12	NA	NA	alpha-bhc	6.8E-13	4.3E-12
aniline	5.6E-12	2.9E-04	2.0E-08	aniline	2.0E-12	1.1E-14
anthracene	4.4E-12	3.0E-01	1.5E-11	anthracene	5.7E-03	NA
antimony	NA	4.0E-04	NA	antimony	1.6E-12	NA
aroclor 1016	1.9E-11	7.0E-05	2.7E-07	aroclor 1016	NA	NA
aroclor 1254	7.0E-12	2.0E-05	3.5E-07	aroclor 1254	6.8E-12	NA
arsenic	NA	3.0E-04	NA	arsenic	2.5E-12	NA
barium	NA	1.4E-04	NA	barium	NA	NA
benzene	1.6E-07	NA	NA	benzene	1.2E+01	5.8E-09
benzidine	3.6E-11	3.0E-03	1.2E-08	benzidine	NA	6.5E-09
benzoic acid	1.2E-11	4.0E-00	3.0E-12	benzoic acid	4.3E-12	NA
benzo(a)anthracene	6.3E-15	NA	NA	benzo(a)anthracene	3.9E-01	8.8E-16
benzo(a)pyrene	7.5E-15	NA	NA	benzo(a)pyrene	2.7E-15	1.0E-14
benzo(b)fluoranthene	2.2E-14	NA	NA	benzo(b)fluoranthene	8.0E-15	3.1E-15
benzo(k)fluoranthene	7.5E-14	NA	NA	benzo(k)fluoranthene	2.7E-14	3.9E-01
benzyl alcohol	1.6E-10	3.0E-01	5.3E-10	benzyl alcohol	5.6E-11	1.0E-14
benzyl chloride	4.1E-09	NA	NA	benzyl chloride	1.5E-09	2.5E-10
beryllium	NA	5.0E-03	NA	beryllium	NA	8.4E+00
beta-bhc	1.6E-13	NA	NA	beta-bhc	5.6E-14	1.0E+00
beta-chloronaphthalene	6.9E-10	8.0E-02	8.6E-09	beta-chloronaphthalene	2.5E-10	NA
bis(2-chloro-1-methylethyl)ether	2.7E-09	NA	NA	bis(2-chloro-1-methylethyl)ether	9.7E-10	3.4E-02

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Intake Equation	=	CS X EF X ED X ET X IR BW X AT	
IR	Inhalation rate of gases (RAGS, 1989)	8.3E-01 m³/h	
EF	Exposure frequency	2.5E+02 days/year	
EDn	Exposure duration for non-carcinogens	2.5E+01 year	
EDc	Exposure duration for carcinogens	2.5E+01 year	
BW	Body weight	7.0E+01 kg	
ATc	Average time for carcinogens (lifetime)	2.6E+04 days	
ATn	Average time for non-carcinogens (EDn x 365)	9.1E+03 days	
ET	Exposure time	8.0E+00 h/d	
Ci	Concentration of chemicals indoors	See Table 4-5	
Chemical Concentrations			
Compound	Concentration (mg/m³)	Concentration (mg/m³)	
bis(2-chloroethyl)ether	2.5E-08	cis-1,2-dichloroethene	4.1E-06
bis(2-ethylhexyl)phthalate	1.4E-12	copper	NA
bromodichloromethane	1.1E-07	cumene	1.4E-07
bromoform	8.6E-08	cyanide	NA
bromomethane	3.8E-05	dibenzof(a,h)anthracene	1.7E-17
cadmium	NA	dibromochloromethane	3.0E-06
carbazole	3.2E-12	dichlorodifluoromethane	2.5E-04
carbon disulfide	8.7E-06	dielardin	1.2E-10
carbon tetrachloride	2.1E-06	diethyl phthalate	4.1E-10
chlordane	2.3E-10	di-n-butylphthalate	7.3E-10
chlorobenzene	6.2E-07	di-n-octylphthalate	3.4E-12
chloroform	2.4E-06	endosulfan	8.6E-11
chloromethane	9.2E-05	ethyl chloride	6.8E-12
chromium iii	NA		5.6E-06
chromium vi	NA		
chrysene	2.2E-14		

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Compound	CDI (mg/kg-d)	RD (mg/kg-d)	UH (unitless)	Non-Carcinogenic Calculation		Carcinogenic Calculation	
bis(2-chloroethyl)ether	1.6E-09	NA	4.6E-12	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	CDI (mg/kg-d)	UR (unitless)
bis(2-ethylhexyl)phthalate	9.3E-14	2.0E-02	3.7E-07	5.8E-10	2.5E+00	8.4E-03	1.4E-09
bromodichloromethane	7.3E-09	2.0E-02	2.8E-07	3.1E-14	1.3E-01	2.6E-09	2.8E-16
bromoform	5.6E-09	2.0E-02	1.4E-03	2.6E-09	2.0E-09	3.9E-03	3.4E-10
bromomethane	2.5E-06	NA	NA	NA	NA	NA	7.8E-12
cadmium	NA	5.0E-04	NA	8.9E-07	NA	NA	NA
carbazole	2.1E-13	NA	NA	NA	1.5E+01	NA	NA
carbon disulfide	5.7E-07	2.0E-01	2.8E-06	7.5E-14	2.0E-02	NA	1.5E-15
carbon tetrachloride	1.4E-07	7.0E-04	2.0E-04	2.0E-07	NA	NA	NA
chlordane	1.5E-11	6.0E-05	2.5E-07	4.9E-08	1.5E-01	NA	7.4E-09
chlorobenzene	4.0E-08	5.7E-03	7.1E-06	5.4E-12	1.2E+00	NA	6.5E-12
chloroform	1.5E-07	1.0E-02	1.5E-05	1.4E-08	NA	NA	NA
chloromethane	6.0E-06	NA	NA	5.5E-08	1.9E-02	NA	1.0E-09
chromium iii	NA	1.0E+00	NA	2.1E-06	6.3E-03	NA	1.4E-08
chromium vi	NA	5.0E-03	NA	NA	NA	NA	NA
chrysene	1.4E-15	NA	NA	NA	5.1E+02	NA	NA
cis-1,2-dichloroethene	2.7E-07	1.0E-02	2.7E-05	5.1E-16	3.9E-02	NA	2.0E-17
copper	NA	3.7E-02	NA	NA	9.5E-08	NA	NA
cumene	9.0E-09	2.6E-03	3.5E-06	NA	NA	NA	NA
cyanide	NA	2.0E-02	NA	NA	3.2E-09	NA	NA
dibenzof(a,h)anthracene	1.1E-18	NA	NA	NA	NA	NA	NA
dibromochloromethane	1.9E-07	2.0E-02	9.7E-06	3.8E-19	4.1E+00	NA	1.6E-18
dichlorodifluoromethane	1.6E-05	5.7E-02	2.9E-04	6.9E-08	9.4E-02	NA	6.5E-09
dieidrin	7.5E-12	5.0E-05	1.5E-07	5.8E-06	NA	NA	NA
diethyl phthalate	2.7E-11	8.0E-01	3.3E-11	2.7E-12	1.6E+01	NA	4.3E-11
di-n-butyl phthalate	4.8E-11	1.0E-01	4.8E-10	9.5E-12	NA	NA	NA
di-n-octyl phthalate	2.2E-13	2.0E-02	1.1E-11	1.7E-11	NA	NA	NA
endosulfan	5.6E-12	6.0E-03	9.3E-10	8.0E-14	NA	NA	NA
endrin	4.4E-13	3.0E-04	1.5E-09	2.0E-12	NA	NA	NA
ethyl chloride	3.6E-07	2.9E+00	1.3E-07	1.6E-13	NA	NA	NA

Compound	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	UR (unitless)
bis(2-chloroethyl)ether	5.8E-10	2.5E+00	3.1E-14	8.4E-03	1.4E-09
bis(2-ethylhexyl)phthalate	2.6E-09	1.3E-01	2.0E-09	3.9E-03	2.8E-16
bromodichloromethane	2.0E-09	NA	NA	NA	3.4E-10
bromoform	NA	NA	NA	NA	7.8E-12
bromomethane	NA	NA	NA	NA	NA
cadmium	NA	NA	NA	NA	NA
carbazole	7.5E-14	2.0E-02	2.0E-07	NA	NA
carbon disulfide	2.0E-07	NA	NA	NA	NA
carbon tetrachloride	4.9E-08	1.5E-01	NA	NA	7.4E-09
chlordane	5.4E-12	1.2E+00	NA	NA	6.5E-12
chlorobenzene	1.4E-08	NA	NA	NA	NA
chloroform	5.5E-08	1.9E-02	NA	NA	1.0E-09
chloromethane	2.1E-06	6.3E-03	NA	NA	1.4E-08
chromium iii	NA	NA	NA	NA	NA
chromium vi	NA	NA	NA	NA	NA
chrysene	5.1E-16	3.9E-02	NA	NA	NA
cis-1,2-dichloroethene	9.5E-08	NA	NA	NA	NA
copper	NA	NA	NA	NA	NA
cumene	NA	NA	NA	NA	NA
cyanide	NA	NA	NA	NA	NA
dibenzo(a,h)anthracene	3.8E-19	4.1E+00	NA	NA	1.6E-18
dibromochloromethane	6.9E-08	9.4E-02	NA	NA	6.5E-09
dichlorodifluoromethane	5.8E-06	NA	NA	NA	NA
dieidrin	2.7E-12	1.6E+01	NA	NA	4.3E-11
diethyl phthalate	9.5E-12	NA	NA	NA	NA
di-n-butyl phthalate	1.7E-11	NA	NA	NA	NA
di-n-octyl phthalate	8.0E-14	NA	NA	NA	NA
endosulfan	2.0E-12	NA	NA	NA	NA
endrin	1.6E-13	NA	NA	NA	NA
ethyl chloride	1.3E-07	NA	NA	NA	NA

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Intake Equation	=	CS X EF X ED X ET X IR BW X AT
IR	Inhalation rate of gases (RAGS, 1989)	8.3E-01 m³/h
EF	Exposure frequency	2.5E+02 days/year
EDn	Exposure duration for non-carcinogens	2.5E+01 year
EDc	Exposure duration for carcinogens	2.5E+01 year
BW	Body weight	7.0E+01 kg
ATc	Average time for carcinogens (lifetime)	2.6E+04 days
ATn	Average time for non-carcinogens (EDn x 365)	9.1E+03 days
ET	Exposure time	8.0E+00 h/d
Ci	Concentration of chemicals indoors	See Table 4-5
Chemical Concentrations		
Compound	Concentration (mg/m³)	Concentration (mg/m³)
ethylbenzene	1.2E-06	1.1E-06
fluoranthene	4.1E-12	9.7E-06
fluorene	8.8E-10	1.9E-06
gamma-bhc	1.5E-10	NA
heptachlor	4.2E-09	9.4E-11
heptachlor epoxide	2.5E-09	NA
hexachlorobenzene	8.5E-09	7.2E-11
hexachlorobutadiene	7.7E-09	9.9E-09
hexachlorocyclopentadiene	6.3E-08	1.9E-10
hexachloroethane	4.6E-09	2.0E-04
indeno(1,2,3-cd)pyrene	9.0E-16	1.4E-08
isobutyl alcohol	3.6E-07	1.0E-12
isophorone	1.6E-09	5.8E-07
mercury	NA	4.0E-10
methoxychlor		
methyl methacrylate		

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RFD (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ⁻¹	UR (unitless)
ethylbenzene	7.8E-08	2.9E-01	2.7E-07	2.8E-08	NA	NA
fluoranthene	2.6E-13	4.0E-02	6.6E-12	9.4E-14	NA	NA
fluorene	5.7E-11	4.0E-02	1.4E-09	2.0E-11	NA	NA
gamma-bhc	9.7E-12	3.0E-04	3.2E-08	3.5E-12	1.1E+00	3.8E-12
heptachlor	2.8E-10	5.0E-04	5.5E-07	9.9E-11	5.7E+00	5.6E-10
heptachlor epoxide	1.6E-10	1.3E-05	1.2E-05	5.7E-11	1.3E+01	7.4E-10
hexachlorobenzene	5.6E-10	8.0E-04	6.9E-07	2.0E-10	1.8E+00	3.6E-10
hexachlorobutadiene	5.0E-10	2.0E-04	2.5E-06	1.8E-10	7.8E-02	1.4E-11
hexachlorocyclopentadiene	4.1E-09	2.0E-05	2.0E-04	1.5E-09	NA	NA
hexachloroethane	3.0E-10	1.0E-03	3.0E-07	1.1E-10	3.9E-02	4.2E-12
indenol(1,2,3-cd)pyrene	5.9E-17	NA	NA	2.1E-17	3.9E-01	8.1E-18
isobutyl alcohol	2.4E-08	3.0E-01	7.8E-08	8.4E-09	NA	NA
isophorone	1.0E-10	2.0E-01	5.0E-10	3.6E-11	9.5E-04	3.4E-14
mercury	NA	8.6E-05	NA	NA	NA	NA
methoxy chlor	6.7E-13	5.0E-03	1.3E-10	2.4E-13	NA	NA
methyl methacrylate	2.9E-07	8.0E-02	3.6E-06	1.0E-07	NA	NA
methylene bromide	7.3E-08	1.0E-02	7.3E-06	2.6E-08	NA	NA
methylene chloride	6.3E-07	8.6E-01	7.4E-07	2.3E-07	3.5E-03	7.9E-10
methyl-tert-butyl ether	1.2E-07	8.6E-01	1.4E-07	4.4E-08	NA	NA
moibdenum	NA	5.0E-03	NA	NA	NA	NA
n-butylbenzyl phthalate	6.1E-12	2.0E-01	3.1E-11	2.2E-12	NA	NA
nickel	NA	2.0E-02	NA	NA	9.1E-01	NA
nitroaniline, o-nitrobenzene	4.7E-12	5.7E-05	8.2E-08	1.7E-12	NA	NA
nitrosodiphenylamine, p-nitrosodimethylamine	6.4E-10	5.7E-04	1.1E-06	2.3E-10	NA	NA
n-nitroso-di-n-propylamine	1.2E-11	NA	NA	4.4E-12	2.2E-02	9.7E-14
n-nitrosodiphenylamine	1.3E-05	NA	NA	4.5E-06	1.6E+01	7.3E-05
o-chlorotoluene	9.0E-10	NA	NA	3.2E-10	7.0E+00	2.2E-09
p-chloro-m-cresol	6.5E-14	NA	NA	2.3E-14	9.0E-03	2.1E-16
	3.8E-08	2.0E-02	1.9E-06	1.4E-08	NA	NA
	2.6E-11	NA	NA	9.2E-12	NA	NA

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

$$\text{Intake Equation} = \frac{\text{CS} \times \text{EF} \times \text{ED} \times \text{ET} \times \text{IR}}{\text{BW} \times \text{AT}}$$

IR	Inhalation rate of gases (RAGS, 1989)	8.3E-01 m ³ /h
EF	Exposure frequency	2.5E+02 days/year
EDn	Exposure duration for non-carcinogens	2.5E+01 year
EDc	Exposure duration for carcinogens	2.5E+01 year
BW	Body weight	7.0E+01 kg
ATc	Average time for carcinogens (lifetime)	2.6E+04 days
ATn	Average time for non-carcinogens (EDn x 365)	9.1E+03 days
ET	Exposure time	8.0E+00 h/d
Ci	Concentration of chemicals indoors	See Table 4-5

Chemical Concentrations

Compound	Concentration (mg/m ³)	Compound	Concentration (mg/m ³)
pentachlorophenol	7.7E-11	zinc	NA
phenol	5.9E-10		
pyrene	2.2E-12		
selenium	NA		
silver	NA		
styrene	1.2E-07		
tetrachloroethene	2.7E-07		
toluene	1.5E-06		
toxaphene	3.9E-10		
trans-1,2-dichloroethene	4.2E-06		
trichloroethene	3.1E-06		
trichlorofluoromethane	1.3E-05		
vanadium	NA		
vinyl acetate	7.6E-07		
vinyl chloride	8.8E-04		
xylenes	2.4E-07		

Table C-2 (cont.)
Summary of Unit Risk Characterization
On-Property Commercial Industrial User
Via Inhalation of Indoor Air

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	RID (mg/kg-d)	UH (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	UR (unitless)
pentachlorophenol	5.0E-12	3.0E-02	1.7E-10	1.8E-12	1.8E-02	3.2E-14
phenol	3.8E-11	6.0E-01	6.4E-11	1.4E-11	NA	NA
pyrene	1.5E-13	3.0E-02	4.9E-12	5.2E-14	NA	NA
selenium	NA	5.0E-03	NA	NA	NA	NA
silver	NA	5.0E-03	NA	NA	NA	NA
styrene	7.5E-09	2.9E-01	2.6E-08	2.7E-09	NA	NA
tetrachloroethylene	1.8E-08	1.8E-02	1.8E-06	6.3E-09	2.1E-02	1.3E-10
toluene	9.5E-08	1.1E-01	8.3E-07	3.4E-08	NA	NA
toxaphene	2.5E-11	NA	NA	9.1E-12	1.2E+00	1.1E-11
trans-1,2-dichloroethylene	2.7E-07	2.0E-02	1.4E-05	9.7E-08	NA	NA
trichloroethylene	2.0E-07	NA	NA	7.2E-08	1.0E-02	7.2E-10
trichlorofluoromethane	8.2E-07	2.0E-01	4.1E-06	2.9E-07	NA	NA
vanadium	NA	7.0E-03	NA	NA	NA	NA
vinyl acetate	4.9E-08	5.7E-02	8.6E-07	1.8E-08	NA	NA
vinyl chloride	5.7E-05	NA	NA	2.0E-05	2.7E-01	5.5E-06
xylenes	1.5E-08	2.0E+00	7.7E-09	5.5E-09	NA	NA
zinc	NA	3.0E-01	NA	NA	NA	NA

Compound	Non-Carcinogenic Calculation			Carcinogenic Calculation		
	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	UR (unitless)	CDI (mg/kg-d)	CSF (mg/kg-d) ¹	UR (unitless)
pentachlorophenol	1.8E-12	1.8E-02	NA	1.8E-12	1.8E-02	3.2E-14
phenol	6.4E-11	NA	NA	1.4E-11	NA	NA
pyrene	4.9E-12	NA	NA	5.2E-14	NA	NA
selenium	NA	NA	NA	NA	NA	NA
silver	NA	NA	NA	NA	NA	NA
styrene	2.6E-08	NA	NA	2.7E-09	NA	NA
tetrachloroethylene	1.8E-06	NA	NA	6.3E-09	2.1E-02	1.3E-10
toluene	1.1E-01	NA	NA	3.4E-08	NA	NA
toxaphene	NA	NA	NA	9.1E-12	1.2E+00	1.1E-11
trans-1,2-dichloroethylene	2.0E-02	NA	NA	9.7E-08	NA	NA
trichloroethylene	NA	NA	NA	7.2E-08	1.0E-02	7.2E-10
trichlorofluoromethane	2.0E-01	NA	NA	2.9E-07	NA	NA
vanadium	7.0E-03	NA	NA	NA	NA	NA
vinyl acetate	5.7E-02	NA	NA	1.8E-08	NA	NA
vinyl chloride	8.6E-07	NA	NA	2.0E-05	2.7E-01	5.5E-06
xylenes	7.7E-09	NA	NA	5.5E-09	NA	NA
zinc	3.0E-01	NA	NA	NA	NA	NA

Appendix D

Table D-1
Summary of Health-Based Remediation Goals
Via Future On-Property Construction Worker Scenario

Chemicals of Concern	Hazard Quotient				Incremental Lifetime Cancer Risk			
	Soil (mg/kg)		Risk based Concentration HQ=0.2		Soil (mg/kg)		Risk based Concentration	
	Total Unit HQ (unitless)	Scaled Soil Concentration HQ=0.2	Unit ILCR (unitless)	ILCR=1E-06	Unit ILCR (unitless)	ILCR=1E-06	Concentration ILCR=1E-06	ILCR=1E-06
1-butanol	1.01E-05	1.98E+04	1.98E+04	NA	4.49E-10	NA	NA	NA
1,1-dichloroethane	1.46E-05	1.37E+04	1.37E+04	NA	2.23E+03	2.23E+03	1.57E+01	1.57E+01
1,1-dichloroethene	1.83E-03	1.09E+02	1.09E+02	NA	6.37E-08	1.57E+01	NA	NA
1,1,1,2-tetrachloroethane	4.01E-04	4.98E+02	4.98E+02	NA	1.54E-09	6.48E+02	6.48E+02	NA
1,1,2-trichloroethane	3.16E-04	6.34E+02	6.34E+02	NA	4.48E-09	2.23E+02	2.23E+02	NA
1,1,2,2-tetrachloroethane	NA	NA	NA	NA	1.60E-08	6.25E+01	6.25E+01	NA
1,2-dibromo-3-chloropropane	8.37E-03	2.39E+01	2.39E+01	NA	4.13E-07	2.42E+00	2.42E+00	NA
1,2-dibromoethane	2.83E-03	7.06E+01	7.06E+01	NA	2.06E-07	4.86E+00	4.86E+00	NA
1,2-dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-dichloroethane	NA	NA	NA	NA	4.84E-09	2.06E+02	2.06E+02	NA
1,2-dichloropropane	5.93E-03	3.37E+01	3.37E+01	NA	1.04E-08	9.61E+01	9.61E+01	NA
1,2-diphenylhydrazine	NA	NA	NA	NA	4.92E-08	2.03E+01	2.03E+01	NA
1,2,3-trichloropropane	2.02E-04	9.90E+02	9.90E+02	NA	4.18E-07	2.39E+00	2.39E+00	NA
1,2,4-trichlorobenzene	1.15E-03	1.74E+02	1.74E+02	NA	NA	NA	NA	NA
1,3-dichloropropene	4.14E-03	4.83E+01	4.83E+01	NA	1.07E-08	9.36E+01	9.36E+01	NA
1,4-dichlorobenzene	3.66E-07	5.46E+05	5.46E+05	NA	2.31E-09	4.32E+02	4.32E+02	NA
2-butanone	6.09E-06	3.28E+04	3.28E+04	NA	NA	NA	NA	NA
2-chlorophenol	2.33E-04	8.57E+02	8.57E+02	NA	NA	NA	NA	NA
2-methylphenol	2.31E-05	8.66E+03	8.66E+03	NA	1.02E-07	9.81E+00	9.81E+00	NA
2-naphthylamine	NA	NA	NA	NA	NA	NA	NA	NA
2,4-dichlorophenol	3.84E-03	5.21E+01	5.21E+01	NA	NA	NA	NA	NA
2,4-dimethylphenol	5.75E-05	3.48E+03	3.48E+03	NA	NA	NA	NA	NA
2,4-dinitrophenol	5.74E-03	3.49E+01	3.49E+01	NA	NA	NA	NA	NA
2,4-dinitrotoluene	5.74E-03	3.48E+01	3.48E+01	NA	1.76E-08	5.70E+01	5.70E+01	NA
2,4,5-trichlorophenol	1.15E-05	1.73E+04	1.73E+04	NA	NA	NA	NA	NA
2,4,6-trichlorophenol	NA	NA	NA	NA	3.97E-09	2.52E+02	2.52E+02	NA
2,6-dinitrotoluene	1.15E-03	1.74E+02	1.74E+02	NA	3.85E-08	2.59E+01	2.59E+01	NA
3,3-dichlorobenzidine	NA	NA	NA	NA	6.79E-08	1.47E+01	1.47E+01	NA
4-chloroaniline	2.89E-03	6.93E+01	6.93E+01	NA	NA	NA	NA	NA
4-methyl-2-pentanone	1.67E-05	1.20E+04	1.20E+04	NA	NA	NA	NA	NA

Table D-1 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Construction Worker Scenario

Chemicals of Concern	Hazard Quotient				Incremental Lifetime Cancer Risk			
	Total Unit HQ (unitless)	Soil (mg/kg) Scaled Soil Concentration HQ=0.2	Risk based Concentration HQ=0.2	Soil (mg/kg)	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06	
4-methylphenol	2.30E-03	8.69E+01	8.69E+01	NA	9.69E-09	1.03E+02	1.03E+02	
4,4-ddd	NA	NA	NA	NA	1.37E-08	7.28E+01	7.28E+01	
4,4-dde	NA	NA	NA	NA	1.37E-08	7.28E+01	7.28E+01	
4,4-ddt	1.64E-02	1.22E+01	1.22E+01	NA	NA	NA	NA	
acenaphthene	2.47E-05	8.10E+03	8.10E+03	NA	NA	NA	NA	
acetone	1.29E-05	1.55E+04	1.55E+04	NA	NA	NA	NA	
acrolein	NA	NA	NA	NA	NA	NA	NA	
acrylonitrile	1.27E-03	1.57E+02	1.57E+02	NA	6.28E-08	1.59E+01	1.59E+01	
aldrin	2.73E-01	7.32E-01	7.32E-01	NA	6.88E-07	1.45E+00	1.45E+00	
alpha-bhc	NA	NA	NA	NA	2.55E-07	3.93E+00	3.93E+00	
aniline	5.43E-05	3.69E+03	3.69E+03	NA	3.23E-10	3.10E+03	3.10E+03	
anthracene	4.93E-05	4.06E+03	4.06E+03	NA	NA	NA	NA	
antimony	2.21E-02	9.05E+00	9.05E+00	NA	NA	NA	NA	
aroclor 1016	NA	NA	NA	NA	NA	NA	NA	
aroclor 1254	2.30E-01	8.70E-01	8.70E-01	NA	NA	NA	NA	
arsenic	2.26E-02	8.87E+00	8.87E+00	NA	5.01E-08	2.00E+01	2.00E+01	
barium	7.91E-05	2.52E+03	2.52E+03	NA	NA	NA	NA	
benzene	NA	NA	NA	NA	6.98E-09	1.43E+02	1.43E+02	
benzidine	3.84E-03	5.21E+01	5.21E+01	NA	2.84E-05	3.52E-02	3.52E-02	
benzoic acid	2.87E-06	6.96E+04	6.96E+04	NA	NA	NA	NA	
benzo(a)anthracene	NA	NA	NA	NA	8.74E-08	1.14E+01	1.14E+01	
benzo(a)pyrene	NA	NA	NA	NA	8.74E-07	1.14E+00	1.14E+00	
benzo(b)fluoranthene	NA	NA	NA	NA	8.74E-08	1.14E+01	1.14E+01	
benzo(k)fluoranthene	NA	NA	NA	NA	8.74E-08	1.14E+01	1.14E+01	
benzyl alcohol	1.16E-05	1.73E+04	1.73E+04	NA	NA	NA	NA	
benzyl chloride	NA	NA	NA	NA	9.97E-09	1.00E+02	1.00E+02	
beryllium	1.28E-02	1.56E+01	1.56E+01	NA	1.77E-12	5.65E+05	5.65E+05	
beta-bhc	NA	NA	NA	NA	7.27E-08	1.38E+01	1.38E+01	
beta-chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	
bis(2-chloro-1-methylethyl)ether	NA	NA	NA	NA	4.02E-09	2.49E+02	2.49E+02	

Table D-1 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Construction Worker Scenario

Chemicals of Concern	Hazard Quotient					
	Total Unit HQ (unitless)	Soil (mg/kg)	Scaled Soil Concentration HQ=0.2	Risk based Concentration HQ=0.2	Incremental Lifetime Cancer Risk	
	Total Unit ILCR (unitless)	Soil (mg/kg)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06	Total Unit ILCR (unitless)	Soil (mg/kg)
bis(2-chloroethyl)ether	NA	NA	NA	NA	1.45E-07	6.91E+00
bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	4.75E-10	2.10E+03
bromodichloromethane	6.02E-04	3.32E+02	3.32E+02	7.1E-09	1.30E+02	2.10E+03
bromoform	5.98E-04	3.34E+02	3.34E+02	4.58E-10	2.18E+03	2.18E+03
bromonmethane	NA	NA	NA	NA	NA	NA
cadmium	1.22E-02	1.64E+01	1.64E+01	3.16E-12	3.16E+05	3.16E+05
carbazole	NA	NA	NA	1.13E-09	8.83E+02	8.83E+02
carbon disulfide	1.40E-04	1.43E+03	1.43E+03	NA	NA	NA
carbon tetrachloride	NA	NA	NA	1.03E-08	9.71E+01	9.71E+01
chloroform	1.92E-01	1.04E+00	1.04E+00	6.81E-08	1.47E+01	1.47E+01
chlorobenzene	NA	NA	NA	NA	NA	NA
chloroform	1.34E-03	1.49E+02	1.49E+02	1.90E-09	5.27E+02	5.27E+02
chloromethane	NA	NA	NA	NA	1.35E-09	7.43E+02
chromium iii	6.21E-06	3.22E+04	3.22E+04	NA	NA	NA
chromium vi	2.46E-04	8.14E+02	8.14E+02	1.03E-08	9.73E+01	9.73E+01
chrysene	NA	NA	NA	8.74E-09	1.14E+02	1.14E+02
cis-1,2-dichloroethene	1.49E-04	1.34E+03	1.34E+03	NA	NA	NA
copper	1.59E-04	1.26E+03	1.26E+03	NA	NA	NA
cumene	5.28E-05	3.79E+03	3.79E+03	NA	NA	NA
cyanide	2.86E-04	6.99E+02	6.99E+02	NA	NA	NA
dibenz(a,h)anthracene	NA	NA	NA	2.98E-07	3.35E+00	3.35E+00
dibromochloromethane	7.19E-05	2.78E+03	2.78E+03	6.67E-09	1.50E+02	1.50E+02
dichlorodifluoromethane	9.34E-05	2.14E+03	2.14E+03	NA	NA	NA
dieldrin	1.64E-01	1.22E+00	1.22E+00	6.47E-07	1.54E+00	1.54E+00
diethyl phthalate	1.44E-06	1.39E+05	1.39E+05	NA	NA	NA
di-n-butylphthalate	1.15E-05	1.74E+04	1.74E+04	NA	NA	NA
di-n-octylphthalate	5.74E-04	3.49E+02	3.49E+02	NA	NA	NA
endosulfan	1.37E-03	1.46E+02	1.46E+02	NA	NA	NA
endrin	2.73E-02	7.33E+00	7.33E+00	NA	NA	NA
ethyl chloride	1.41E-06	1.42E+05	1.42E+05	NA	NA	NA

Table D-1 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Construction Worker Scenario

Chemicals of Concern	Hazard Quotient						Incremental Lifetime Cancer Risk					
	Soil (mg/kg)			Soil (mg/kg)			Soil (mg/kg)			Risk based Concentration		
	Total Unit HQ (unitless)	Scaled Soil Concentration HQ=0.2	Risk based Concentration HQ=0.2	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06
ethylbenzene	NA	2.87E-05	6.97E+03	NA	NA	NA	NA	NA	NA	NA	NA	NA
fluoranthene		2.88E-05	6.94E+03	6.94E+03	NA	NA	NA	NA	NA	NA	NA	NA
fluorene		2.65E-03	7.56E+01	7.56E+01	4.31E-08	2.32E+01	2.32E+01	2.32E+01	2.32E+01	2.32E+01	2.32E+01	2.32E+01
gamma-bhc		2.48E-02	8.06E+00	8.06E+00	3.49E-07	2.87E+00	2.87E+00	2.87E+00	2.87E+00	2.87E+00	2.87E+00	2.87E+00
heptachlor		6.36E-01	3.14E-01	3.14E-01	5.30E-07	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00
heptachlor epoxide		NA	NA	NA	1.03E-07	9.69E+00	9.69E+00	9.69E+00	9.69E+00	9.69E+00	9.69E+00	9.69E+00
hexachlorobenzene		NA	NA	NA	4.47E-09	2.24E+02	2.24E+02	2.24E+02	2.24E+02	2.24E+02	2.24E+02	2.24E+02
hexachlorobutadiene		2.25E-03	8.87E+01	8.87E+01	NA	NA	NA	NA	NA	NA	NA	NA
hexachloroethane		1.16E-03	1.73E+02	1.73E+02	2.23E-09	4.49E+02	4.49E+02	4.49E+02	4.49E+02	4.49E+02	4.49E+02	4.49E+02
indeno[1,2,3-cd]pyrene		NA	NA	NA	6.79E-08	1.47E+01	1.47E+01	1.47E+01	1.47E+01	1.47E+01	1.47E+01	1.47E+01
isobutyl alcohol		4.16E-06	4.81E+04	4.81E+04	NA	NA	NA	NA	NA	NA	NA	NA
isophorone		5.77E-06	3.47E+04	3.47E+04	5.41E-11	1.85E+04	1.85E+04	1.85E+04	1.85E+04	1.85E+04	1.85E+04	1.85E+04
mercury		2.95E-02	6.78E+00	6.78E+00	NA	NA	NA	NA	NA	NA	NA	NA
methoxychlor		2.30E-03	8.71E+01	8.71E+01	NA	NA	NA	NA	NA	NA	NA	NA
methyl methacrylate		1.88E-04	1.06E+03	1.06E+03	NA	NA	NA	NA	NA	NA	NA	NA
methylene bromide		1.32E-04	1.51E+03	1.51E+03	NA	NA	NA	NA	NA	NA	NA	NA
methylene chloride		1.87E-04	1.07E+03	1.07E+03	NA	NA	NA	NA	NA	NA	NA	NA
methy-l-tert-butyl ether		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
moiybdenum		1.61E-04	1.24E+03	1.24E+03	NA	NA	NA	NA	NA	NA	NA	NA
n-butylbenzyl phthalate		5.75E-05	3.48E+03	3.48E+03	NA	NA	NA	NA	NA	NA	NA	NA
nickel		8.37E-04	2.39E+02	2.39E+02	NA	1.92E-13	5.21E+06	5.21E+06	5.21E+06	5.21E+06	5.21E+06	5.21E+06
nitroaniline, o-		2.48E-05	8.07E+03	8.07E+03	NA	NA	NA	NA	NA	NA	NA	NA
nitrobenzene		2.32E-03	8.61E+01	8.61E+01	NA	NA	NA	NA	NA	NA	NA	NA
nitrosodiphenylamine, p-		NA	NA	NA	1.25E-09	8.02E+02	8.02E+02	8.02E+02	8.02E+02	8.02E+02	8.02E+02	8.02E+02
n-nitrosodimethylamine		NA	NA	NA	3.85E-06	2.60E+01	2.60E+01	2.60E+01	2.60E+01	2.60E+01	2.60E+01	2.60E+01
n-nitroso-di-n-propylamine		NA	NA	NA	4.03E-07	2.48E+00	2.48E+00	2.48E+00	2.48E+00	2.48E+00	2.48E+00	2.48E+00
n-nitrosodiphenylamine		NA	NA	NA	5.09E-10	1.96E+03	1.96E+03	1.96E+03	1.96E+03	1.96E+03	1.96E+03	1.96E+03
p-chlorotoluene		6.38E-05	3.14E+03	3.14E+03	NA	NA	NA	NA	NA	NA	NA	NA
p-chloro-m-cresol		5.75E-06	3.48E+04	3.48E+04	NA	NA	NA	NA	NA	NA	NA	NA

Table D-1 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Construction Worker Scenario

Incremental Lifetime Cancer Risk

Ingestional Lifetime Cancer Risk		Soil (mg/kg)		Risk based Concentration	
Total Unit ILCR (unitless)	Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	ILCR=1E-06	ILCR=1E-06	ILCR=1E-06
1.75E-09		5.72E+02		5.72E+02	
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
2.98E-09		3.36E+02		3.36E+02	
NA	NA	NA	NA	NA	NA
6.81E-08		1.47E+01		1.47E+01	
NA	NA	NA	NA	NA	NA
9.55E-10		1.05E+03		1.05E+03	
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
1.94E-07		5.16E+00		5.16E+00	
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Table D-2
Summary of Health-Based Remediation Goals
Via Future On-Property Commercial Industrial Scenario

Chemicals of Concern	Hazard Quotient				Incremental Lifetime Cancer Risk			
	Soil (mg/kg)		Risk based Concentration HQ=0.2		Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Soil (mg/kg)	Risk based Concentration ILCR=1E-06
	Total Unit HQ (unitless)	Scaled Soil Concentration HQ=0.2	Risk based Concentration HQ=0.2	NA	NA	NA	NA	NA
1-butanol	5.78E-06	3.46E+04	3.46E+04	NA	9.11E-10	1.10E+03	1.10E+03	1.10E+03
1,1-dichloroethane	3.13E-06	6.38E+04	6.38E+04	NA	2.38E-07	4.21E+00	4.21E+00	4.21E+00
1,1-dichloroethene	6.16E-05	3.24E+03	3.24E+03	NA	8.00E+05	6.97E-11	1.44E+04	1.44E+04
1,1,1,2-tetrachloroethane	2.50E-07	8.00E+05	8.00E+05	NA	2.59E+04	7.93E-10	1.26E+03	1.26E+03
1,1,2-trichloroethane	7.71E-06	NA	NA	NA	NA	6.68E-10	1.50E+03	1.50E+03
1,1,2,2-tetrachloroethane	NA	NA	NA	NA	NA	1.34E-08	7.47E+01	7.47E+01
1,2-dibromo-3-chloropropane	9.37E-05	2.13E+03	2.13E+03	NA	1.06E-03	1.88E+02	5.43E-09	1.84E+02
1,2-dibromoethane	1.06E-03	1.88E+02	1.88E+02	NA	7.58E-08	2.64E+06	NA	NA
1,2-dichlorobenzene	7.58E-08	2.64E+06	2.64E+06	NA	NA	3.76E-09	2.66E+02	2.66E+02
1,2-dichloroethane	NA	NA	NA	NA	5.36E-03	3.73E+01	1.38E-07	7.25E+00
1,2-dichloropropane	NA	NA	NA	NA	1.63E-06	1.22E+05	4.24E-15	2.36E+08
1,2-diphenylhydrazine	NA	NA	NA	NA	4.22E-09	4.74E+07	2.45E-08	4.08E+01
1,2,3-trichloropropane	NA	NA	NA	NA	1.34E-05	1.49E+04	1.51E-09	NA
1,2,4-trichlorobenzene	NA	NA	NA	NA	7.01E-09	2.85E+07	2.29E-11	4.37E+04
1,3-dichloropropene	NA	NA	NA	NA	8.51E-08	2.35E+06	NA	NA
1,4-dichlorobenzene	NA	NA	NA	NA	1.71E-07	1.17E+06	NA	NA
2-butanone	NA	NA	NA	NA	2.64E-09	7.59E+07	NA	NA
2-chlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2-methylphenol	NA	NA	NA	NA	8.99E-09	2.22E+07	6.13E-13	1.63E+06
2-naphthylamine	NA	NA	NA	NA	4.58E-10	4.37E+08	NA	NA
2,4-dichlorophenol	NA	NA	NA	NA	2.80E-11	7.14E+09	NA	NA
2,4-dimethylphenol	NA	NA	NA	NA	5.92E-10	3.38E+08	1.31E-13	7.62E+06
2,4-dinitrophenol	NA	NA	NA	NA	9.04E-10	2.21E+08	NA	NA
2,4,6-trichlorophenol	NA	NA	NA	NA	9.13E-09	2.19E+07	9.07E-14	1.10E+07
2,6-dinitrotoluene	NA	NA	NA	NA	3.08E-08	6.50E+06	2.22E-12	4.51E+05
3,3-dichlorobenzidine	NA	NA	NA	NA	2.93E-07	6.84E+05	1.33E-15	7.53E+08
4-chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA
4-methyl-2-pentanone	NA	NA	NA	NA	NA	NA	NA	NA

Table D-2 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Commercial Industrial Scenario

Chemicals of Concern	Hazard Quotient			Incremental Lifetime Cancer Risk			
	Total Unit HQ (unitless)	Scaled Soil Concentration HQ=0.2	Soil (mg/kg)	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06	NA
4-methylphenol	4.99E-09	4.01E+07	4.01E+07	NA	1.00E-15	9.97E+08	9.97E+08
4,4-ddd	NA	NA	NA	3.54E-13	2.83E+06	2.83E+06	
4,4-dde	NA	NA	NA	4.42E-15	2.26E+08	2.26E+08	
4,4-ddt	7.28E-11	2.75E+09	2.75E+09	NA	NA	NA	
acenaphthene	1.23E-09	1.62E+08	1.62E+08	NA	NA	NA	
acetone	4.58E-07	4.37E+05	4.37E+05	NA	NA	NA	
acrolein	2.48E-03	8.05E+01	8.05E+01	NA	NA	NA	
acrylonitrile	6.40E-05	3.12E+03	3.12E+03	1.31E-08	7.65E+01	7.65E+01	
aldrin	1.95E-07	1.03E+06	1.03E+06	3.55E-11	2.82E+04	2.82E+04	
alpha-bhc	NA	NA	NA	4.31E-12	2.32E+05	2.32E+05	
aniline	1.96E-08	1.02E+07	1.02E+07	1.14E-14	8.77E+07	8.77E+07	
anthracene	1.46E-11	1.37E+10	1.37E+10	NA	NA	NA	
antimony	NA	NA	NA	NA	NA	NA	
aroclor 1016	2.72E-07	7.35E+05	7.35E+05	NA	NA	NA	
aroclor 1254	3.51E-07	5.69E+05	5.69E+05	NA	NA	NA	
arsenic	NA	NA	NA	NA	NA	NA	
barium	NA	NA	NA	NA	NA	NA	
benzene	NA	NA	NA	5.84E-09	1.71E+02	1.71E+02	
benzidine	1.21E-08	1.66E+07	1.66E+07	6.46E-09	1.55E+02	1.55E+02	
benzoic acid	3.04E-12	6.58E+10	6.58E+10	NA	NA	NA	
benzo(a)anthracene	NA	NA	NA	8.84E-16	1.13E+09	1.13E+09	
benzo(a)pyrene	NA	NA	NA	1.05E-14	9.56E+07	9.56E+07	
benzo(b)fluoranthene	NA	NA	NA	3.13E-15	3.19E+08	3.19E+08	
benzo(k)fluoranthene	NA	NA	NA	1.05E-14	9.56E+07	9.56E+07	
benzyl alcohol	5.25E-10	3.81E+08	3.81E+08	NA	NA	NA	
benzyl chloride	NA	NA	NA	2.48E-10	4.03E+03	4.03E+03	
beryllium	NA	NA	NA	NA	NA	NA	
beta-bhc	NA	NA	NA	1.01E-13	9.94E+06	9.94E+06	
beta-chloronaphthalene	8.64E-09	2.32E+07	2.32E+07	NA	NA	NA	
bis(2-chloro-1-methylethyl)ether	NA	NA	NA	3.41E-11	2.93E+04	2.93E+04	

Table D-2 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Commercial Industrial Scenario

Chemicals of Concern	Hazard Quotient				Incremental Lifetime Cancer Risk			
	Total Unit HQ (unitless)	Unit HQ (unitless)	Soil (mg/kg) Scaled Soil Concentration HQ=0.2	Risk based Concentration HQ=0.2	Total Unit ILCR (unitless)	Unit ILCR (unitless)	Soil (mg/kg) Scaled Soil Concentration ILCR=1E-06	Risk based Concentration ILCR=1E-06
bis(2-chloroethyl)ether	NA	NA	NA	NA	1.45E-09	6.91E+02	6.91E+02	6.91E+02
bis(2-ethylhexyl)phthalate	4.65E-12	4.30E+10	4.30E+10	4.30E+10	2.79E-16	3.59E+09	3.59E+09	3.59E+09
bromodichloromethane	3.66E-07	5.47E+05	5.47E+05	5.47E+05	3.40E-10	2.94E+03	2.94E+03	2.94E+03
bromoform	2.81E-07	7.13E+05	7.13E+05	7.13E+05	7.81E-12	1.28E+05	1.28E+05	1.28E+05
bromomethane	1.74E-03	1.15E+02	1.15E+02	1.15E+02	NA	NA	NA	NA
cadmium	NA	NA	NA	NA	NA	NA	NA	NA
carbazole	NA	NA	NA	NA	1.50E-15	6.66E+08	6.66E+08	6.66E+08
carbon disulfide	2.84E-06	7.04E+04	7.04E+04	7.04E+04	NA	NA	NA	NA
carbon tetrachloride	1.98E-04	1.01E+03	1.01E+03	1.01E+03	7.41E-09	1.35E+02	1.35E+02	1.35E+02
chlordane	2.51E-07	7.96E+05	7.96E+05	7.96E+05	6.46E-12	1.55E+05	1.55E+05	1.55E+05
chlorobenzene	7.07E-06	2.83E+04	2.83E+04	2.83E+04	NA	NA	NA	NA
chloroform	1.54E-05	1.30E+04	1.30E+04	1.30E+04	1.04E-09	9.58E+02	9.58E+02	9.58E+02
chloromethane	NA	NA	NA	NA	1.35E-08	7.40E+01	7.40E+01	7.40E+01
chromium iii	NA	NA	NA	NA	NA	NA	NA	NA
chromium vi	NA	NA	NA	NA	NA	NA	NA	NA
chrysene	NA	NA	NA	NA	1.98E-17	5.06E+10	5.06E+10	5.06E+10
cis-1,2-dichloroethene	2.66E-05	7.51E+03	7.51E+03	7.51E+03	NA	NA	NA	NA
copper	NA	NA	NA	NA	NA	NA	NA	NA
cumene	3.49E-06	5.73E+04	5.73E+04	5.73E+04	NA	NA	NA	NA
cyanide	NA	NA	NA	NA	NA	NA	NA	NA
dibenzof(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
dibromochloromethane	9.69E-06	2.06E+04	2.06E+04	2.06E+04	1.58E-18	6.34E+11	6.34E+11	6.34E+11
dichlorodifluoromethane	2.85E-04	7.01E+02	7.01E+02	7.01E+02	NA	NA	NA	NA
dieldrin	1.51E-07	1.33E+06	1.33E+06	1.33E+06	4.30E-11	2.33E+04	2.33E+04	2.33E+04
diethyl phthalate	3.32E-11	6.03E+09	6.03E+09	6.03E+09	NA	NA	NA	NA
di-n-butylphthalate	4.77E-10	4.19E+08	4.19E+08	4.19E+08	NA	NA	NA	NA
di-n-octylphthalate	1.11E-11	1.80E+10	1.80E+10	1.80E+10	NA	NA	NA	NA
endosulfan	9.33E-10	2.14E+08	2.14E+08	2.14E+08	NA	NA	NA	NA
endrin	1.46E-09	1.37E+08	1.37E+08	1.37E+08	NA	NA	NA	NA
ethyl chloride	1.28E-07	1.57E+06	1.57E+06	1.57E+06	NA	NA	NA	NA

Table D-2 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Commercial Industrial Scenario

Chemicals of Concern	Hazard Quotient				Incremental Lifetime Cancer Risk			
	Soil (mg/kg)		Risk based Concentration HQ=0.2		Soil (mg/kg)		Risk based Concentration ILCR=1E-06	
	Total Unit HQ (unitless)	Scaled Soil Concentration HQ=0.2	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06	Total Unit ILCR (unitless)	Scaled Soil Concentration ILCR=1E-06
ethylbenzene	2.73E-07	7.33E+05	7.33E+05	NA	NA	NA	NA	NA
fluoranthene	6.60E-12	3.03E+10	3.03E+10	NA	NA	NA	NA	NA
fluorene	1.43E-09	1.40E+08	1.40E+08	NA	NA	NA	NA	NA
gamma-bhc	3.22E-08	6.20E+06	6.20E+06	3.80E-12	2.63E+05	2.63E+05	NA	NA
heptachlor	5.52E-07	3.62E+05	3.62E+05	5.62E-10	1.78E+03	1.78E+03	NA	NA
heptachlor epoxide	1.23E-05	1.63E+04	1.63E+04	7.41E-10	1.35E+03	1.35E+03	NA	NA
hexachlorobenzene	6.94E-07	2.88E+05	2.88E+05	3.57E-10	2.80E+03	2.80E+03	NA	NA
hexachlorobutadiene	2.52E-06	7.95E+04	7.95E+04	1.40E-11	7.13E+04	7.13E+04	NA	NA
hexachlorocyclopentadiene	2.04E-04	9.79E+02	9.79E+02	NA	NA	NA	NA	NA
hexachloroethane	3.01E-07	6.65E+05	6.65E+05	4.19E-12	2.39E+05	2.39E+05	NA	NA
indenof[1,2,3-cd]pyrene	NA	NA	NA	8.15E-18	1.23E+11	1.23E+11	NA	NA
isobutyl alcohol	7.84E-08	2.55E+06	2.55E+06	NA	NA	NA	NA	NA
isophotone	5.04E-10	3.97E+08	3.97E+08	3.42E-14	2.92E+07	2.92E+07	NA	NA
mercury	NA	NA	NA	NA	NA	NA	NA	NA
methoxychlor	1.35E-10	1.48E+09	1.48E+09	NA	NA	NA	NA	NA
methyl methacrylate	3.60E-06	5.56E+04	5.56E+04	NA	NA	NA	NA	NA
methylene bromide	7.27E-06	2.75E+04	2.75E+04	NA	NA	NA	NA	NA
methylene chloride	7.38E-07	2.71E+05	2.71E+05	7.91E-10	1.26E+03	1.26E+03	NA	NA
methyl-tert-butyl ether	1.44E-07	1.39E+06	1.39E+06	NA	NA	NA	NA	NA
molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
n-butylbenzyl phthalate	3.07E-11	6.52E+09	6.52E+09	NA	NA	NA	NA	NA
nickel	NA	NA	NA	NA	NA	NA	NA	NA
nitroaniline, o-	8.18E-08	2.45E+06	2.45E+06	NA	NA	NA	NA	NA
nitrobenzene	1.12E-06	1.78E+05	1.78E+05	NA	NA	NA	NA	NA
nitrosodiphenylamine, p-	NA	NA	NA	9.71E-14	1.03E+07	1.03E+07	NA	NA
n-nitrosodimethylamine	NA	NA	NA	7.27E-05	1.38E-02	1.38E-02	NA	NA
n-nitroso-di-n-propylamine	NA	NA	NA	2.24E-09	4.46E+02	4.46E+02	NA	NA
n-nitrosodiphenylamine	NA	NA	NA	2.09E-16	4.80E+09	4.80E+09	NA	NA
o-chlorotoluene	1.90E-06	1.05E+05	1.05E+05	NA	NA	NA	NA	NA
p-chloro-m-cresol	NA	NA	NA	NA	NA	NA	NA	NA

Table D-2 (cont.)
Summary of Health-Based Remediation Goals
Via Future On-Property Commercial Industrial Scenario

Appendix E

4.4.2 Background Evaluation

All of the inorganic constituents believed to be associated with permitted RCRA facility operations and SWMUs at the site also occur naturally in soils, and, therefore, in air, surface water, and groundwater. In addition, concentrations of some inorganics in environmental media have been increased by general human activity. Inorganic constituents that have been added to environmental media as a result of regional human activity, such as automobile emissions, are referred to as anthropogenic (or man-made) background. This would also apply to PAHs, PCDDs, and PCDFs.

To evaluate whether inorganics detected in soils at the site are part of natural or anthropogenic background, or whether these inorganic originated from site operations, a statistical method of comparison was used. Concentrations of inorganics that were detected in potentially impacted areas of the site were compared to concentrations representative of regional and site-specific background. Regional background values and descriptive statistics were obtained from existing literature (Shacklette and Boerngen, 1984), and these values are presented for comparison only. The characterization of site-specific soil background is described in the following paragraphs.

Background soil samples were collected at various depths from unimpacted areas of the site and analyzed for inorganic constituents during the QLSV, RCRA Closure activities and the RFI. The background sample locations are outside of areas previously used for manufacturing and waste management practices, and areas of potential impact based on existing data presented in the Closure Certification Report (Geraghty & Miller, 1995), QLSV Results (Geraghty & Miller, 1994a), and the RFI Report (Geraghty & Miller, 1996). For the purposes of the risk assessment, background locations were selected systematically and are assumed to be representative of site-specific background. The boring and sample identification numbers for locations used to estimate background distributions of inorganic constituents are listed in Table 4-4.



Total inorganics were analyzed in soil samples collected from the QLSV boring at 7 feet and 50 feet bgs and during Closure activities at depths of approximately 7 and 15 feet bgs. Six background soil borings were advanced during the RFI to approximately 75 feet bgs and samples were collected at 5 foot intervals. At least one sample was analyzed from each discernible lithologic unit in each boring. Background soil samples were analyzed for VOCs, SVOCs, metals, and pH. The RFI background samples were not analyzed for all metals, but only for those that were determined to be of interest at the site based on the results of the initial RFI, QLSV and Closure sampling and analyses. The metals analyses were performed to provide site-specific distributions of inorganic constituent concentrations that represent naturally-occurring and anthropogenic background. Analyses for VOCs and SVOCs were conducted to confirm that the background locations were not impacted by the site operations. VOCs were detected in planned background boring B-04 and, therefore, inorganic data from this boring were not considered to represent background.

The background distribution of each inorganic constituent was tested for normality using the Shapiro-Wilk goodness-of-fit test for large sample sizes, or the Kolmogorov-Smirnov Lilliefors goodness-of-fit test for small sample sizes (Gilbert, 1987). Overall background sample distributions that were determined to represent normal or lognormal distributions at a ninety-five percent confidence level are indicated as such in Table 4-5. For several of the inorganic constituents, overall background distributions did not meet the goodness of fit criteria for a normal or lognormal distribution. However, distributions of inorganics were expected to be associated with lithology. Therefore, background distributions of a few inorganics (aluminum, arsenic, and barium) were evaluated for normality by lithology. The background distributions of these three constituents were divided into two sets (fine grained soils and coarse grained soils) by lithology and tested separately for normality. Each of these three constituents was normally distributed in fine grain soils, but not in coarse grain soils. The geology of the site is relatively complex, consisting of coarser, sandy soils, interbedded with clay/silt lenses, which does not lend itself to simple classification by depth. Because the overall background distribution of soil concentrations was non-normal (for all lithologies) for these three constituents, but their distributions in shallow fine grain soils were normal, it was assumed that these three constituents



were normally distributed for each independent lithology at the site. Based on the results for these three constituents, it was also assumed that all inorganic constituents with similar overall site distributions are normally distributed for each lithologic unit.

A boxplot and a normal quantile plot were prepared for the overall background distribution of soil concentrations for each inorganic constituent. The boxplots summarize the data based on the median, quartiles, and extreme values and convey information about spread and skewness. The normal quantile plot is prepared by plotting the quantiles of a variable's distribution against the quantiles of the normal distribution, which provides a graphical representation of the goodness-of-fit of the data to a normal distribution. These plots were provided in Appendix B of the RFI report (Geraghty & Miller, 1996). A boxplot and a normal quantile plot also were prepared for the distributions of each inorganic constituent in all samples collected at the site, including both background and impacted area locations (Geraghty & Miller, 1996). The boxplot for the site-wide distribution can indicate extreme values that are not consistent with the overall distribution (including background) of the constituent at the site. Such extreme values may represent site impacts or they may represent statistically anomalous results. The normal quantile plot for the site-wide distribution of all site samples provides a graphical representation of the goodness-of-fit of the site data to a single normally distributed population. If the normal quantile data points fell on a straight line, the data were considered to represent a single normal distribution. If a straight line formed by the data points clearly changed direction (or slope), the data were considered to have originated from more than one normally distributed population. If the data points did not form a straight line, the distribution was determined to be non-normal.

For each inorganic constituent, a background comparison value was identified and is presented in Table 4-5. The background comparison value is the maximum concentration of the constituent that is assumed to represent background when detected at the site. If the constituent was not detected above the PQL in more than 40 percent of the background sample analyses, the maximum detected value was used as the background comparison value. If the constituent was



not detected at all in the background soil samples, then the arithmetic mean of the PQLs was identified as the background comparison value.

For inorganic constituents detected in 60 percent or more of the background samples, 95 percent and 99 percent upper tolerance levels (UTLs) were calculated. The 95 percent UTL is based upon a 95 percent probability that at least 95 percent of the complete background distribution is less than the UTL. The 99 percent UTL is based upon a 95 percent probability that at least 99 percent of the complete background distribution is less than the UTL. In these cases, the 99 percent UTL was identified as the background comparison value for all inorganic constituents except chromium and arsenic. The normal quantile plots for chromium and arsenic clearly indicated that overall site data originated from more than one normally distributed population. In the case of chromium, the change in slope observed on the normal quantile plot corresponded with the 95 percent UTL. Thus, the 95 percent UTL was identified as the background comparison value for chromium. In the case of arsenic, the change in slope on the normal quantile plot was associated with a value greater than the 99% UTL. This value of 14 milligrams per kilogram (mg/kg) represents the potential change from background to site-related population and was, therefore, used as the background comparison value for arsenic.

The 95 percent and 99 percent UTLs were calculated based upon the background sample mean and standard deviation. For moderately censored data sets (many nondetects), the median was used as an unbiased estimate of the population mean, and is presented in Table 4-5 as the estimate of the mean (Gilbert, 1987). For lognormally distributed background data, the arithmetic mean of the nontransformed data was used as a statistically unbiased estimator of the population mean where the coefficient of variation was less than 1.2 (Gilbert, 1987).

For each inorganic constituent, the concentration detected in each individual soil sample was compared to the background comparison value shown in Table 4-5. If the concentration detected exceeded the background comparison value, the constituent was determined to be potentially site-related. If the concentration detected was lower than or equal to the background comparison value, the constituent in that sample was determined to represent background. The



site specific background comparison value was also used to develop PDCVs. Where health-based values were less than the background comparison values, the PDCVs equaled the background comparison value. Inorganic soil concentrations above the PDCVs, therefore, were determined to be site-related.

The development of site-specific background comparison values described in the preceding paragraphs was performed using background samples collected during the first phase of the RFI. Soil samples collected during supplemental soil RFI indicated the presence of low levels of PCDDs and PCDFs at the site. The incidence, concentrations, and distribution of PCDDs/PCDFs at the site were evaluated and determined not to be associated with site operations. The evaluation of PCDDs and PCDFs and a presentation of urban background concentrations of PCDDs/PCDFs is provided in Appendix G.

Site-specific background for surface water was characterized by the constituent concentrations detected in the upgradient sample. One surface water sample (SW-1) was collected at the upgradient edge of the storm drain on the ILM facility. The upgradient sample was collected during the same sampling event as on-site and downgradient samples. Concentrations of constituents detected in this upgradient sample originated from off-site, upgradient sources. The single upgradient sample collected is not statistically representative of concentrations originating from off-site sources. It does, however, provide an indication of the nature and magnitude of concentrations that are not site-related in surface water at the site.

The only organic analyte detected in the upgradient surface water sample (SW-1) was total oil and grease at 218 milligrams per liter (mg/L). Total oil and grease was detected in on-site surface water samples SW-2, SW-3, and SW-4, at concentrations of 39, 8 and 5 mg/L, respectively, and at a concentration of 10 mg/L at the downgradient edge of the site (SW-5). The surface water data indicate that total oil and grease detected in surface water at the site is likely to have originated from off-site sources.



A background characterization has not yet been performed for groundwater at the site. For the purposes of this BRA, it was assumed that all analytes detected in the first round of groundwater sampling beneath the site were site-related. Given the industrial nature of the surrounding properties, it is very likely that at least some of the constituents detected in groundwater at the site originated from off-site sources. The assumption made for this BRA is, therefore, very conservative and should be re-evaluated subsequent to further characterization of groundwater impacts at the site and the surrounding area.

Table 4-5. Evaluation of Site-Specific Background for Metals in Soil, Lockheed Martin Corporation, International Light Metals Division, Los Angeles, California.

Constituent	Frequency of Detect	Avg PQL	Distribution	Mean	Standard Deviation	Maximum Detected Concentration	X + 3StdDev	95% UTL	99% UTL	Background Comparison Value
Aluminum	48 / 48	6.6	non-normal	11,120	8,019	26,500	27,158	35,177	30,285	36,300
Antimony	0 / 48	5	-	-	-	-	-	-	-	5 g
Arsenic	48 / 48	0.5	non-normal	2.46	1.3	7	5.06	6.36	6	7
Barium	48 / 48	0.5	non-normal	77	65	257	207	272	232	14 c
Beryllium	16 / 48	0.5	non-normal	-	-	0.74	-	-	-	281
Cadmium	4 / 48	0.5	non-normal	-	-	0.88	-	-	-	0.74 d
Calcium	18 / 18	3.8	lognormal	6,621	8,733	38,000	24,087	32,820	31,239	38,951
Chromium	48 / 48	0.5	normal	19.5	9	64	37.5	46.5	41	0.88 d
Cobalt	30 / 48	2.5	non-normal	5.6 b	4.5	14	14.6	19.1	16	20
Copper	48 / 48	0.5	lognormal	17	12	53	41	53	46	55
Iron	17 / 17	12.5	normal	19,735	10,860	32,900	41,455	52,315	50,773	53 f
Lead	26 / 48	2.5	non-normal	3.3 c	17	111	37.3	54.3	44	111 d
Lithium	14 / 18	5	normal	10,59 a	4,635	18.8	19.89	24.54	24	28
Magnesium	18 / 18	2.5	normal	5,096	3,256	10,300	11,608	14,864	14,275	17,150
Manganese	18 / 18	2.5	normal	349	282	1,080	913	1,195	1,144	1,393
Mercury	1 / 48	0.2	-	-	0.28	-	-	-	-	0.28 d
Molybdenum	1 / 48	2.5	-	-	-	23	-	-	-	23 d
Nickel	48 / 48	2.5	non-normal	11 a	5.6	23	22.2	27.8	24	29
Potassium	18 / 18	10	normal	2,601	1,529	5,200	5,659	7,188	6,911	8,261
Selenium	0 / 30	0.5	-	-	-	-	-	-	-	8,261
Silver	11 / 48	1	-	-	-	6.2	-	-	-	0.5 g
Sodium	18 / 18	2.8	normal	584	371	1,520	1,326	1,697	1,630	1,957
Strontium	18 / 18	5	normal	52	34.6	120	121.2	155.8	150	180
Thallium	0 / 48	11	-	-	-	-	-	-	-	6.2 d
Titanium	48 / 48	0.5	non-normal	599	430	1,790	1,459	1,889	1,627	11 g
Vanadium	48 / 48	0.5	non-normal	29	17	63	80	70	62	1,949
Zinc	48 / 48	2.5	lognormal	43	35	198	113	148	127	153

Table 4-5. Evaluation of Site-Specific Background for Metals in Soil, Lockheed Martin Corporation, International Light Metals Division, Los Angeles, California.

Notes:

All units are milligram per kilogram (mg/kg).

- = Not applicable.

Avg PQL = Average Practical Quantitation Limit

X = Mean

Std Dev = Standard Deviation

UTL = Upper Tolerance Level
Background comparison value is the value against which site concentrations are compared, to determine if site concentrations potentially exceed background and indicate potential metal impacts on-site.

- a: Nondetect results set equal to the value of the PQL.
- b: Nondetect results set equal to 1/2 the PQL.
- c: Due to high percentage of nondetect results, median was used as estimate of the mean.
- d: Maximum value used due to censored nature of background data.
- e: The maximum detected value that was determined to be consistent with the site distribution, and that did not represent an outlier, based on the normal quantile plot, was used as the comparison value.
- f: The maximum detected concentration in background was used as comparison value due to the inappropriateness of assuming normal distribution for calculation of UTL, when underlying distribution is lognormal.
- g: Average value of PQL used as comparison value.

